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# THE PRACTICAL MAGAZINE

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H. R. MARSDEN, ESQ., MAYOR OF LEEDS.

SCARCELY anything can be of more importance than looking after the health of the town. It is by the strong, the able, the energetic, that we live. We all have to look to that class of people for carrying on, not only the work of the town, but for maintaining our position and keeping pace with the times in which we live." These words of Alderman Marsden, on his re-election to the mayoralty of Leeds, his native town, afford an accurate idea of his personal character, and the sentiment is the foundation of a greater part of his public service. Himself a living example of the strong, the able, and the energetic, he is desirous of augmenting the joy of existence among those around him. He sees clearly that, while great cities excite the mind to daring feats, and bring rich rewards to the toiler, the tendency of all the surroundings is inimical to that physical well-being, without which effort is enfeebled, the mind sinks into a species of fatalism, and frequently into reckless despair.

Sprung from the general population, he has emerged from that obscurity by the aid of a sound mind in a sound body, of which, while making no boast, he is not asl amed, and evidently feels that if the conditions of his lot could be made universal, the happiness and prosperity of a country would be assured. In early life he was apprenticed to King Wesley, a manufacturer of engineering tools in Leeds, and at the expiration of his term of service, his skill and industry commended him to the principals of a Leeds workshop, who made him their manager. After the lapse of a few years he, in company with his brother, went to America in search of employment, and in course of time entered into partnership with Messrs. Blake, the eminent engineers and machine makers. Mr. E. P. Blake patented a nut-cracker while Marsden was with him, and its success led him to attempt

an improvement. A machine for the purpose of obtaining the nutritious kernel of a very hard-shelled nut which grew only in the west and south, had long been desired, and a large demand ensued immediately. The principle could be adapted, it was found, to other articles beside the nut, and Blake's house became still more famous. Here Mr. Marsden made a good sum of money, and determined on coming home, in order to develop an idea he had conceived of a machine for crushing stones, and also to exercise a right conferred on him by arrangement with his partners to construct all their machines for the English market. With this foundation he returned to Leeds, and commenced his factory. At that time the road-making business happened to be in a transitional state; the demand for new roads oppressed the market, and some difficulty in getting contracts accepted embarrassed the local authorities, who dreaded mandamuses and indictments as their chief foe. Labour could not be had in sufficient quantity for breaking up the rock quickly enough, and this patent stone-breaker supplied the desired power. It could break forty tons in a day of ten hours, and was suitable for metal. It could do its work at a cost of 3*d.* per ton, and to show its power it crushed up chilled cast iron. This machine obtained the silver medal of the Royal Agricultural Society, and made a commercial position for the inventor, who, returning in 1862, went to work so successfully, that in 1868, at the Leicester meeting, he obtained the prize above named, having gradually added to and improved upon his first idea until he had perfected it. The distinction he had earned may be inferred from the number of medals and other honours which amounted to nearly fifty for this and other inventions and improvements introduced by him to public service, and exhibited in various places as occasion served.

On returning to Leeds he at once took part in the discussion of local affairs on the Liberal side, but with so little acrimony, that, by the desire of both parties, his re-election to the mayoralty met with no opposition. His first accession to office occurred in 1866, when his neighbours made him a councillor for the ward of Holbeck, and from that time his energies have been literally at the service of the town, who conferred on him the honourable position of alderman in 1872.

When the Town Council determined on electing Alderman Marsden their mayor, Alderman Addyman was called on to make the proposal, which he did in these terms: "The gentleman who has been nominated will, I trust, be unanimously elected. Mr. Marsden has sprung from the people, is one of the people. His whole heart and sentiments are in accord with the feelings of the masses, and his election will give pleasure and be gratifying to large numbers of the inhabitants. The working classes would indeed be fairly represented, in having in the chief magistrate one who has come from their ranks, and who has attained his high position by his personal abilities and character, and from the intelligence he possesses and his sterling good sense, is well qualified to discharge the mayoralty duties. Besides this, he is a man of extraordinary benevolence, and has always been ready to give pecuniary aid to every movement having in view the elevation of the masses of the community." The election was a unanimous one; and when Mr. Marsden entered to receive the decision, he briefly engaged to conduct the business to the general interest, and spoke of himself as sure to do his best, by knowing no sect, denomination, or party, but acting impartially towards all. He was especially eligible for the mayoralty, having been mayor's auditor for several years, and therefore well acquainted with all the details of the office.

The Leeds Association of Foremen Engineers took occasion, from his election to the mayoralty, to invite Mr. Marsden to their eighth anniversary, in 1873, about a week after his election, and in proposing the toast "Prosperity to the Association," he referred to the presence of many employers at that and other annual meetings, as an advantage to them, that they met their foremen away from their shops, and could show that good fellowship which should always be a bond among honourable men pursuing one calling in different degrees and positions. After a just recognition of the services of the late Mr. Greenwood to the cause of mechanical science in England, he turned to congratulate them that many had passed from the rank of employed to that of employers. "The calling of a mechanical engineer is one," said he, "of great importance and responsibility, and as it is impossible for an employer to attend to the minutiæ of his works, much of the detail necessarily falls to the hand of the engineer's foreman. I hope the day of foolish suspicion has passed away, so that when a foreman displays sufficent ability and energy to demonstrate his capability as an employer, that body will not look shyly at him, but receive him among them, believing that there was room enough for all, and that there might be as much integrity in a small shop as in a large one. If, as I say, the profession be of so important a character, and influences so greatly the civilization and progress of the world, it must be necessary that we look not on a machine merely as a thing out of which to make money, but should try so to use it in our individual operations as never to send out an imperfect piece of work, for by keeping up the high standard we maintain the reputation of Leeds, and also help to maintain the reputation of England as the first mechanical country in the world."

His own health, in connection with the town and trade of Leeds, having been proposed, the mayor said: "The honour which has recently been conferred upon me by the town reflects, I think, in some degree on the trade with which all of us are connected. Before I was twenty-one I had served a seven years' apprenticeship to the engineering trade, and a very large measure of my success is due to the tuition I received in this town from William King Wesley, a man now eighty years of age, who, twenty or thirty years ago, was one of the leading mechanical engineers in Leeds." Mr. Marsden then illustrated the dependence of one man on the other, and said, "I feel this more now that I am mayor than I did five-and-twenty years ago, when I was foreman to Mr. Joshua Buckton." He then explained the new works for the supply of Leeds with water, and spoke of it as a magnificent scheme which must benefit the town. "The better the water the better it will be for the boilers and for household purposes, and there is no town in the country that can have, if it will, better water than Leeds." He then took a retrospect of the trade of the town, contrasting the present gigantic manufactories, noble warehouses, extensive transactions, and ready transit, with those of a generation ago, and said, still the work of improvement could go on indefinitely. "The iron and machine trades, in which we are specially interested, are revolutionizing the world. Leeds engines, Leeds tools, Leeds planing machines, Leeds lathes, Leeds locomotives, are known everywhere, and it depends to a large extent upon the foremen engineers whether Leeds shall maintain the high and honourable position it has held so long."

At the annual meeting of the Leeds Town Mission, where he was chairman he referred to his experiences in America and at Leeds. The crowds of people who might be seen lounging in our streets on Sundays contrasted strangely with the universal attendance at public worship which he had observed in the city of Newhaven, known as "the land of steady habits"—near New York, and said that a short time ago he attended a crowded meeting at Holbeck (his aldermanic ward), in a place of worship which was poor, because the pews were unlet in the midst of a dense population. He offered to pay for seats for as many of the poor people as would occupy them, so that poverty should be no excuse, but was grieved to find that not one had accepted the gift. That circumstance showed the need for town missions, and they were bound to help to the utmost of their power.

Then, at the fifty-second annual meeting of the Leeds Guardian Asylum (for "unfortunate" women), he spoke of the institution as taking hold of a depressed class of the community and of the successful efforts made for their reformation; and in terms of kindness, said it was very desirable that we should be able to look after these unhappy creatures, for their natural tendency was not to do so themselves.

Take another instance, confirmatory of the remark with which we set out. At the Woodhouse Temperance Hall and Mechanics' Institute's twenty-third anniversary, after speaking of the gratification he felt with the report and the working of the society, he said: "I often think we do not now value lectures as we ought to do now-a-days. I may remind you, a man is valued for his intellect, and I am struck every day with the want of cultivation of the intellect of the people—men and women alike. We can only hold our own by striving with every nerve to do more than our forefathers, and I have considerable hope concerning the future from the present system of education, for, however deficient be the first attempt, it is a step in the right direction, and we being Englishmen will soon find out, in spite of all that may be said of this, that, or the other clause, what is best for the children of this great country; but whatever system is ultimately established, there will ever be work for institutions of this class. As to the debt you have, it is but £70, and here are plenty to help you. I will begin with £10."

Then followed the concert for the Early Closing Association, a local banquet to Mr. Kettlewell on his 75th birthday and 50th year in his own house, anniversary meetings of the Social Improvement Society for denouncing begging, the Leeds Benevolent Strangers' Friend Society, the Harmonic Union, the Working Men's Hall meetings, and many others, in all of which not only his tongue but his wealth and influence were freely at the public service.

The desire to prove the determination of employing official dignity for the general good, is seen in the gift of a singular and effective addition to the Town-hall organ, a noble and powerful instrument, well known in musical circles, by presenting as his

contribution a "carillon stop," which consists of three octaves and a half (44) bells. These are placed in a row on a rail inside the large and principal swell box and are struck by small hammers, the action being similar to that in a pianoforte. They are played on the keys of the choir organ, and can be coupled to any of the stops in the echo, choir, or swell organs. This work he entrusted to Messrs. Gray and Davison, the builders of the instrument, which was made originally for St. James's Hall. Their London artizans under Mr. Hutchince, the local tuner, completed it to the great satisfaction and pleasure of the inhabitants.

This love of music and conviction of its splendid capabilities for benefiting a population led him last year to revive the ancient Leeds Festival for the good of the town hospitals, and a work of stupendous labour it was. We cannot chronicle the particulars of that week's work, but it may be characterized as magnificent. Sir M. Costa took charge of the baton, and "St. Paul," "John the Baptist," "Paradise and the Peri," the "Messiah," and several other works were performed, bringing a net balance to the hospital funds of about £1,600, besides being a great benefit to the general trade of the inhabitants. The guarantee fund had been signed for to the extent of £5,000, but it remained a dead letter under the circumstances. The many good deeds done were crowned by this, and the result did not surprise any one when his re-election was unanimously voted.

In 1874, on his re-election to the presidency of the Athletic Club, after thanking the members, he said: "I take an interest in the club simply because of the benefit it is calculated to afford to all who are connected with it and undergo the physical training it conducts. I am convinced of the advantages of such training by my personal experience, for I attribute the excellent health I have enjoyed through life and my present physical energy at 51 years of age in a very great degree to my having been a member of an athletic club when a very young man. What can be so valuable in life as a good constitution? You just compare a person in that condition with one who is delicate. The one, speaking generally, is proof against the adverse influences of weather; he might almost fall overboard in winter without any bad effects; while the other falls sick from the slightest cause. And what can assist you in securing the priceless boon of health and strength so much as the proper pursuit of athletic exercise in youth? I only regret I cannot do more to aid you, but all I can shall be at your service." When the prizes were competed for at the Gymnasium in Cockridge Street, Leeds, he presided, and the lady mayoress (Mrs. Marsden) distributed the prizes about a fortnight afterwards.

His sympathies extend to all the local public charities which have no narrow basis, and his speeches all partake of the same large-heartedness. He is called Liberal, but there seems to be little evidence of any especially political colour in all his proceedings, but a strong love of progress in every way in which it can be wisely developed.

The people of Leeds, in common with other large centres of industry, rejoiced at the family connection of the British royal family with Russia, as tending to promote the interests of peace and commerce, and Mr. Marsden generously offered a very happy commemoration of the arrival of the Duke and Duchess by a further manifestation of his rich hospitality. Some of the town folk had suggested a banquet, others a ball, but instead of providing a rich spread for those who were not hungry or an extra festivity in a gay season, he determined to furnish a feast for the poor and the aged of the borough, and on every side it was felt that in no way could the chief magistrate do truer honour to himself and the town, or confer more memorable happiness than that he had proposed. Tickets were sent to the charitable institutions (and they are very many in Leeds) and the ministers of all denominations for distribution among the deserving poor, with especial regard for those who were both aged and poor. The old people who were infirm came in cabs or in the private carriages of the rich—generously placed at the mayor's disposal—and were attended to their places by the gentlemen of the town. The number reached 796—184 men and 612 women. Of these only four were under 40; 36 between 40 and 50; 130 between 50 and 60; 296 between 60 and 70; 271 between 70 and 80; 53 between 80 and 90; 3 between 90 and 100; and one 100 years of age. They, for the most part, had never seen the inside of the Victoria Hall. After tea had been cleared, and room made for 300 visitors, Dr. Spark, the local organist, played the Russian Hymn, arranged as an organ solo, and the new carillon stop had its first audience. The mayor then delivered a short speech—indeed, all his speeches are short. "We have met to rejoice, because our Sailor Prince has brought to our shores this day a Princess from Russia, who is worthy of our welcome. Such happy unions add to the peace, dignity, and welfare of our empire, which never prospered as it now does under the gracious rule of Her Majesty Queen Victoria. The addition of the Princess Marie to the royal circle of England adds another bright star to our sovereign's crown. While the people of Russia have lost a charming princess, and the imperial family an amiable and obedient daughter, they have become honourably connected, in our Duke of Edinburgh, with a dutiful son and exemplary prince. I am glad to welcome you all here, and hope you will not think of me or of my official position in connection with this meeting, but that you will think of and pray for the happiness of the newly wedded Prince and Princess who this day have arrived in England."

This meeting ended by the mayor giving to the oldest man a smoking cap, and to the oldest woman a dress cap, and to all his guests a group portrait of the Duke and Duchess of Edinburgh in coloured border. It was a most unique and touching gathering, and will not be forgotten in the history of Leeds, for not only did the invited 796 enjoy themselves and their entertainment, but the poor hanging about the doors were brought in, and on leaving each man had a packet of tobacco and each woman a packet of tea presented to them, and the inmates of the hospitals also shared in the bounty.

But the most celebrated act of Mr. Marsden's mayoralty was the reception he gave to the Duke of Edinburgh on the 15th May, who opened at Leeds the Yorkshire Exhibition of Arts and Manufactures, for the encouragement of the Fine Arts and various manufactures, and for the liquidation of a debt of £10,000 left upon the Leeds Mechanics' Institute and Literary Society.

The building occupied 1½ acres—the site of the Coloured Cloth Hall in Wellington Street, near the railway station. Inside the central space a large hall was erected named the Edinburgh Hall, made of glass, and over 186 ft. in length, and 98 ft. wide and 75 ft. high, supported on forty pillars, with circular ribs, and having at one end an orchestra to contain 500 performers and singers. The collection redounded greatly to the honour of Yorkshire, for besides the Fine Art collection of pictures on loan, every description of goods supplied by the Yorkshire towns were gathered, and large factories with operatives occupied another department, in order to exhibit the general processes. The prince was received by the Mayor, Mr. Wheelhouse, M.P., Earl Fitz-William, Lord Houghton, the Sheriff of Yorkshire, the Mayors of Liverpool and Sheffield, and Mr. Ed. Baines, and was conducted to Avenue House, near Woodhouse Moor, which is Mr. Marsden's residence. After a brief rest the party formed in procession, and returned to the Exhibition, very greatly augmented, and made illustrious by the splendid additional company. On entering, the National Anthem was sung, a prayer offered, the usual address presented by the mayor, and the several departments visited, the procession reformed and moved out to Woodhouse Moor, where 31,000 Sunday School children were assembled, each of whom had been presented with a medal and badge at the expense of the mayor. As the royal carriage passed, the concourse of children sang the National Anthem with fine effect. His Royal Highness attended a banquet at half-past six, and at eight a grand ball with 900 guests completed the programme, the duke leading off the first dance, and then returning to London.

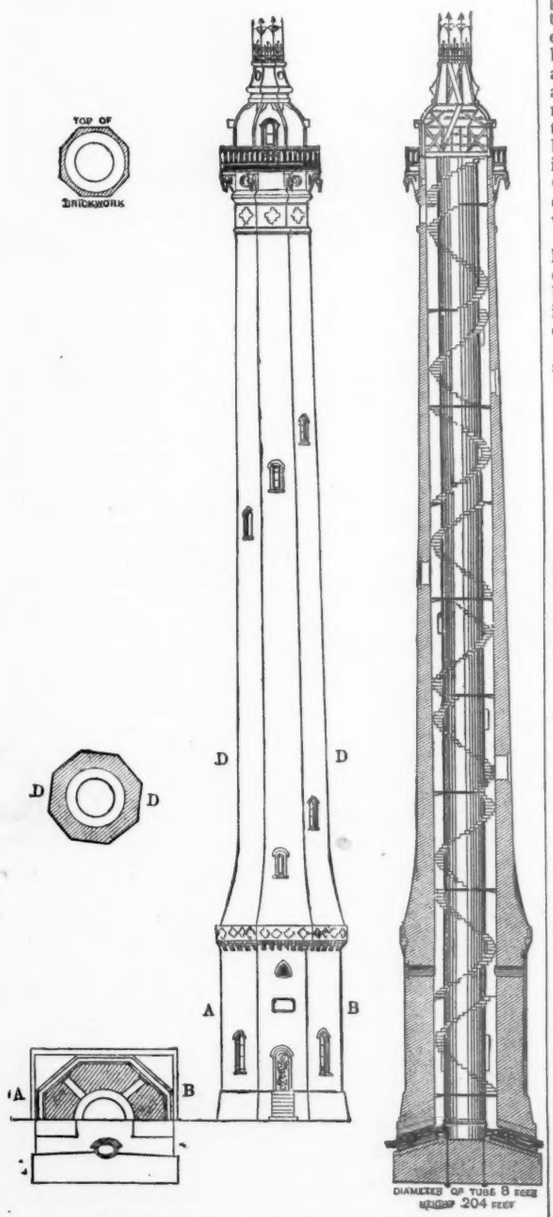
So long as our towns can furnish such instances of public spirit, we may safely rely on a long-continuation of national honour and renown.

## STAND-PIPE FOR BLOOMINGTON, ILL.

IN constructing water-works for western cities, it is frequently impossible to have a reservoir, for want of the necessary elevated ground to place it upon. Many of the cities have, therefore, been contented to adopt the direct supply plan; that is, pumping directly into the distributing mains, the plan adopted by Peter Morice, in the works built for supplying the city of London, at London Bridge, in 1582. The imperfections of such a system are apparent, the supply depends entirely upon the integrity of the machinery; not a drop more can be procured than that which is pumped, and as it is pumped. The oscillations of demand must be answered directly by the operation of the pumps. The capacity of the pumping apparatus must, therefore, be equal to the maximum demand at any moment of the day or night. Expensive and complicated machinery is therefore necessary, little better than that constructed by Peter Morice, so long ago, who had two sets of *gang* pumps, four in each gang to a wheel. Very ingenious, but complicated arrange-

ments have been devised for controlling the velocity of the modern direct supply pumps, by the pressure in the mains. The objection to this plan does not lay only in the complicated and unnecessarily large, expensive machinery, but also in the rapid wear and destruction of the apparatus. Another objection is the constant attention and watchfulness necessary, day and night, to keep up the supply of water, and the machinery in running order.

The stand-pipe is now becoming better understood and appreciated; it can scarcely be considered as a reservoir; still, it may




contain a sufficient volume of water to allow for ordinary repairs, packing, stopping the pumps at night, &c.

The stand-pipe being built for Bloomington will contain 75,000 gallons. This would furnish a supply equal to a second-class steam fire engine, 400 gallons per minute, for one hour and a half, and still leave 100 feet of water in the tower, thus giving valuable protection against fire, should the pumping apparatus, for any cause, not be put into operation at the moment the fire was discovered. In the direct supply plan, not a drop of water could be procured until pumped, and sufficient pressure produced to project the water upon the fire. The stand-pipe has also a value in furnishing a place for the shocks incident to the working of pumps, opening and shutting of stops, and other like disturbing forces, to expend themselves.

The illustration represents an elevation, vertical section, and several cross-sections of the stand-pipe now being constructed for the city of Bloomington, Ill.

The pipe proper, or iron tube, is 200 ft. high and 8 ft. diameter, constructed of plate iron, secured to a cast-iron base-plate. The plate iron varies in thickness from $\frac{5}{8}$ at the bottom to 3-16 at the top. The weight of the iron work will be 56 tons. The pipe is enclosed in brick masonry. The face bricks are white, with red brick trimmings laid in black mortar. 1,539 cubic yards of brick and stone masonry will be required to enclose the pipe. An annular space of 27 in. to be left between the iron tube and the masonry, in which are suitable steps and platforms, leading to the top of the pipe. The tower is pierced with a sufficient number of windows to light the stairs. On the top of the masonry is a dome 20 ft. high, framed with wood, and covered with tin. Outside of this is a gallery supported upon brackets. The top of the dome has a lookout, protected by an ornamental railing, with gilded points.

This tower will present a striking appearance, and will be a landmark for a great distance around the city, and will give it a distinctive characteristic. The prospect from the summit will be grand and extensive, presenting an opportunity rarely had in that section, of looking down upon so wide an extent of country.

The contract price for building the entire structure, as represented in the illustration, is $26,700.

## FRENCH MODE OF DEALING WITH TRADE DISPUTES.

IN the year 1806, when Napoleon, the first emperor, was staying at Lyons, he received complaints from the manufacturers of the city, who still remembered the trade guilds recently abolished, about the abuses and frauds which had crept into trade. A regulation was immediately issued, bearing date March 18, 1806, for repressing some of these abuses, and by it was introduced the special jurisdiction of *prud'hommes* (or experts), whose duty, among other things, was to decide disputes which might arise between masters and men. Other laws and decrees have since introduced various changes, as *e. g.* the decrees of June 11, 1809, and August 3, 1810.

The decree of 1806 confined the institution to the city of Lyons, but granted permission to introduce it in all industrial cities; and at the present day it is stated that more than sixty-six towns in France avail themselves of it. The *prud'hommes* are elected by masters and men possessing certain qualifications specified in the law, and in different numbers, according to the importance of the places of industry. The masters elect one *prud'homme* more than the men, and those elected by them perform the duties of the office gratuitously, while those chosen by the men have a yearly salary allowed them by law.

Their powers are fixed by Art. I. of the decree of August 3, 1810, as follows:—

"The councils of *prud'hommes* are authorized to judge all disputes which arise between tradesmen, manufacturers, managers, foremen, workmen, and journeymen, whatever be the amount in question. Their decisions shall be final and without appeal if the award does not exceed a hundred francs (£4 sterling) altogether. Above a hundred francs an appeal will be allowed."

According to the decree of August 10, 1810, they are empowered, like magistrates, to impose fines and not more than three days' imprisonment for certain offences. Besides this, they act as arbitrators in all disputes that may arise between masters and men, including those in which they cannot decide as judges. The proceedings before them are summary, without formality, and without the expenses of ordinary tribunals.

Where there are no councils of *prud'hommes*, it is enacted by Art. 5, No. 3, of the law of May 25, 1838, that the ordinary jurisdiction of the justices of the peace should supply their place. These reside in every commune, and have authority to arrange all disputes of whatever amount, and decide upon claims not exceeding thirty francs (£1 1*s.*), *i. e.*, most of those which relate to wages.—*L'Economista.*

## NOVEL METHOD OF REPAIRING A COLLAPSED GAS-HOLDER.

THE following account of an accident to a telescopic gas-holder in Buffalo, New York, and the steps taken to repair the damage, are extracted from a long report on the subject in the "Journal of the Franklin Institute."

The particulars of the dimensions of the holder itself are as follows:—Inner section: diameter, 88 ft. 6 in.; height, 22 ft. Outer section: diameter, 90 ft.; height, 22 ft.; cup, depth, 1 ft. 3 in.; width, 6 in.; working contents, 265,722 cubic feet.

The crown has the curvature of a portion of a sphere of 350 ft. radius—equal to 2 ft. $9\frac{5}{8}$ in. rise, and the framing consists of one column king post 1 ft. 8 in. diameter, 14 ft. long, made of sheets $\frac{5}{16}$ in. thick; 16 queen posts, T iron, $3\frac{1}{2}\times3\frac{1}{2}\times\frac{5}{16}$ in.; 16 main rafters, T iron, $4\times4\times\frac{7}{16}$ in.; 32 secondary rafters, angle iron, $3\times3\times\frac{3}{8}$ in.; 16 main tie-rods, $1\frac{1}{4}$ in. round iron; 16 secondary tie-rods, 1 in. round iron; 32 struts to independent trusses, $\frac{7}{8}$ in. round iron; 32 struts to main rafters, $\frac{7}{8}$ in. round iron; 64 tie-rods to main rafters, $\frac{3}{4}$ in. round iron; 80 purlins, flat iron, $2\frac{1}{2}\times\frac{3}{8}$ in.; curb, angle iron, $4\times4\times\frac{7}{16}$ in.; centre sheets, diameter 4 ft. and 3 ft. 6 in. $\times\frac{1}{2}$ in. and $\frac{3}{8}$ in. thicknesses; curb sheets 3 ft. 3 in. wide, and of No. 9 thickness; remaining sheets were of No. 9 and No. 12 thicknesses, and 4 ft. 2 in. long. The 16 legs of inner section are of bulb iron, 45 lb. per yard, with a backing-plate of flat iron, 5 in. $\times\frac{1}{4}$ in. on outside of section, countersunk riveted. The shells of both sections are made of sheets of No. 9 thickness for the upper and lower widths, and the intermediate sheets are of No. 14 thickness.

The work was finished late in November, and on the 4th December the writer, Mr. Robert Briggs, the engineer, received a telegram informing him that the holder had collapsed, and requiring his immediate presence at Buffalo, which place he reached on the middle of the following day.

"An immediate examination of the wreck disclosed the holder with both sections down upon the anchor blocks, and the crown of the inner section introverted on three quarters of the circle with the centre down some $2\frac{1}{2}$ ft. The sheets appeared unhurt, but wrinkled, folded, and buckled, the whole resembling the top view of a demolished umbrella. The man-hole plate was removed, and the water-level was about 4 ft. below the curb. A stream of water was leaking out of one of the bank walls, and a small steam pump was also removing the water from the tank. And the thermometer was about 20° above zero, with a west wind that cut like a knife. A gang of men were removing the retaining wall at the piers on Georgia Street.

An inquiry into the accident revealed that the tank had been filled with water some days, and the holder had been tested on Friday. It had proved excellently, had been blown out twice or more to work out the air, and the inner section had been elevated nearly or quite to full height. (It is not recollected if the outer section had cupped.) As the holder capacity was much needed, it had been put into regular work by the Gas Company. Meanwhile, on Saturday, a leakage was observed, which was found to proceed from a crack in the tank at a column foundation near Georgia Street. After its discovery, the crack rapidly opened, and it was decided to pump down the water 5 ft. or so (to the level of the streets outside), and a small pump was put on to remove the water. At this junction it was decided to discharge the gas once more (as gas was making very fast at the benches) to eliminate the last trace of air from the holder. The inner section was blown off by loosening the man-hole plate, until it rested on the blocks, when the man-hole plate was replaced tightly. All this was done without consultation with the foreman of the ironwork, who had left the holder 8 feet or more out and going up at 4 P.M. on Saturday. Having thus arranged the holder, the gas inlet and outlet had been allowed to remain cut off, with the leakage of the tank and the action of the pump (which continued running during the night) until 3 to 4 A.M. on Sunday, when the crown collapsed with almost explosive violence. Residents of dwellings 600 to 800 ft. distant felt the vibration and shock of the catastrophe.

From the rate of discharge of water from the tank, it is probable that 12″ to 18″ of water pressure were accumulated before the crown yielded, and 180 to 270 tons pressure distributed upon this crown.

The gas was thoroughly displaced when I reached the holder; the cold air outside had descended to the level of the water and expelled the last trace by diffusion, and an internal inspection with lights was possible. An examination from a float exhibited 13 of the 16 main rafters broken in the middle of their length, at the scarfed joint, where the queen posts attach, the breakage being merely the *shearing off* of the scarf piece bolts ($4\frac{5}{8}$ bolts); the parting of all the main tie-rods, either at the king post in the thread portion, or by shearing off the bolt at the gusset next the legs (two of the gussets were torn away from all their bolts); the upsetting, but not shearing off, of all the centre-plate rafter-bolts, and the crippling and springing of many, in fact, most of the flat purlins.

The most striking evidence of the force expended was shown at the centre pier. It was a pyramidal pier 3 ft. 6 in. square at the top, and spreading $1\frac{1}{2}$ in. in 12 in. on all sides; not very soundly built, and with mortar scarcely stiffened in its set; but it was massive, and it was capped by a sound block of Medina stone 3 ft. 6 in. square by about 8 in. thick. The stone would be called good building material anywhere. The stone was cracked to small pieces, and the brick pier below it demolished and also crushed, many of the bricks being broken in fragments as well as displaced. The fracture of the pier was diagonal, as the three tie-rods (and rafters), which were uninjured, had dragged over the foot of the king post about 12 inches to one side.

It did not seem that any serious injury had been done to the internal ironwork structure.

Finding so good appearance within, a new and close examination of the sheets of the crown on the outside was made. Original good iron, the accurate punching of a multiple punch (which punched sixty holes at once, together with accurate laying-out of sheets), and the avoidance of any reaming or stretching of holes when riveting, had produced so good work that no breakage or injury was apparent. Not a seam showed signs of a crack cr opening, and although the buckles were (some of them) 2 ft. or more in depth, and very short (5 ft. to 8 ft. between crests of the waves), no bent plate could be found. With all this, it is proper to assert that the appearance of the top of the crown to an engineer or practical mechanic, without close examination, was truly hopeless for restoration; and some opinions of very positive character had been given the Gas Company previous to my arrival in the city.

The result of the examination in my own mind was to advise the pumping out of the tank as quickly as possible, before a snow-fall, then to be expected daily, should load the crown, and cause further injury; and, after the emptying of the tank to the level of about 1 ft. above the anchor blocks, to enter the holder with a gang of men, have it closed, and blown up with air; and, when the crown should be reverted to its original place by the pressure, to straighten and shore up the rafters one by one; to block up the king post from the centre, and, having thus replaced the crown, relieve it of the air pressure, and, letting out the gang of men, then proceed at leisure to repair the sheared and broken bolts.

The proposition was at once accepted; but, simple as the measure, and perfectly safe the method, it was found merely impossible to impress either upon the workmen. Divers who were practised in hours of work in the water at the bottom of Lake Erie, objected to the *risk* in this immense reservoir of 130,000 cubic feet of air. Carpenters feared the pressure, although they were assured they might be exposed to greater difference any summer's day. Gas workmen could think of nothing but explosion. And, after reasoning with several, the writer found the only alternative was to remain in Buffalo, and lead himself.

An examination of the tank showed three cracks from the top of the wall downwards, caused by insufficient backing. Two of these cracks followed the line of junction of column piers, and the third was intermediate (about half way) between the two piers. In accordance with the advice of the writer, the backing at this place was excavated, and the earth removed to the very bottom of the tank wall, and a revetment pier of 8 ft. projection and 3 ft. width, behind the wall at the base, with a batter of $1\frac{1}{2}$ to 12 towards the tank as it came up, was built. From this revetment pier, two wings of brickwork were built to abut the column piers at their groin with the tank wall. From much experience, it can be said that the attempt to make a tank wall tight by pointing or grouting a crack, is nearly always a failure, and that all efforts short of revetment piers are so nearly direct waste of money, that no engineer is justified in advising them.

Of course, this work of reparation of the tank had to be done under temporary cover, and also, of course, strict regulation was had as to walking on the crown in its precarious state.

The means for supply of air for the proposed operation, at the works of Buffalo Gaslight Company, were singularly favourable. The Company had been making a partial hydro-carbon gas from anthracite coal and super-heated steam, by means of a generator of the type introduced into this country forty years since by Faber du Faur (which gas was afterwards carburetted by benzine vapour *fixed* in it by passage through low-heated retorts). The generator was supplied by air by a Blake air-pump

having a capacity of 500 to 600 cubic feet of air per minute, and it was convenient to take the air by a line of 3 in. wrought iron pipes to the holder; there was an opening on the delivery of the air-pump available for this purpose.

If, however, it had happened that no such supply of air were at hand, it would have been feasible by means of four to six ordinary smith's bellows and a line of soldered tin pipe to have air under suitable pressure at the rate of 60 to 90 cubic feet per minute, with, of course, some disadvantage in time. For the engine pump would lift the holder 1 ft. in ten minutes, while the suggested bellows would have taken an hour and a half for the same result.

The preliminaries of pipe line, and all other steps essential to the success of the scheme, were effected in readiness.

It was late on Thursday afternoon before the water in the tank was low enough to expose sufficient part of the conical bottom to work upon. At this time the water was 3½ ft. to 4 ft. deep at the sides.

There had been taken into the holder and deposited about the centre of the cone, during the day, thirty lengths of hemlock scantling, 3″ × 6″ × 22′, with other joists and boards for scaffolding, together with a pile of blocking timber, tools, &c.; and at about eight o'clock, after several callings of the roll, ten out of twelve men were found.

Some experiments demonstrated that conversation could not be carried on, and a set of signals had been arranged. The order of repetition of raps on the inside of crown was made into a telegraphic communication between the *ins* and the *outs*. Of course it had to be very simple, as the occasion did not demand an extensive code. The inside of the holder was illuminated by forty or fifty 4 in. candles, secured to the rods of the crown by bits of copper wire. After calling roll, everything being ready, the foreman of the gasworks volunteering to act as outside director, the gang of men descended into the abyss, and the man-hole was bolted down. A little delay ensued by one man having gone home (near by) to inform his family of his undertaking, and by his declining to join in the risk after his return, and the missing men came to the holder, one joining, and the other, after listening a few moments at the man-hole, and hearing no sound, solemnly pronounced them "all dead," and went his own way, above ground, in fear!

The ladders having been displaced, and the men put in such position that the fall of rods or rafters might not hurt them (only one end of one rod fell down), the proper signal was given, and the pump was started. In about a minute an evident noise of shaking sheet iron was heard; in five minutes the king post was free from its centre pier, and the resonance of sheets was like distant theatrical thunder. In ten minutes the whole crown was inflated, and in about twelve minutes the outside director signalled that the inner section was 3 in. afloat from the anchor-blocks, and that he had stopped the air-pump, as agreed upon. On the inside the centre pier was levelled off, and the king post blocked up and wedged, when, at the signal, the air plug was opened, the holder dropped upon the anchors, and the discharge of air stopped, thus thrusting up the centre, and removing part of the *apple* shape. (It was supposed, when this was done, that 3 in. would have been enough, but subsequently it appeared that the holder should have been lifted about 9 in., and then dropped, to have effected the end entirely.)

The thirteen broken-backed rafters were then found to be depressed in their middles (half way from edge to centre) from 2 ft. to 3¼ ft. (except one which was detached from its position, and dropped 5 ft. or 6 ft.) The restoration was exceedingly easy; one by one they were quick-shored and spur-shored by the 22 ft. scantling and blocking, offering some resistance and squirming as they passed the toggel line. They were shored up to the apparent proper curve without any attempt at exactness. As the work proceeded, the king post was straightened up, and finally lifted off from its blocking. When this occurred, a signal was made, and the section was raised again, the shores being watched to see that they were not loosened, and 4 in. of blocking more inserted under the king post, when the section was by signal again anchored. After this, some of the rafters had to be further shored up. The whole work of shoring up the 13 rafters occupied four and a half hours.

The work had been done in the night in preference, so as to ensure the undisturbed attention of the external requirements. It was an intensely cold night outside, but a few degrees above zero, and the clear sky gave a radiation through the thin plates of the crown, yet within the holder it was about 40 degrees and only chilly, and at the last smoky from candle smoke, but otherwise not uncomfortable.

At two o'clock in the morning the signal was given, the man-hole was loosened and removed, and the workmen emerged. The exterior of the crown showed that the gradual lifting of the rafters had again elevated the whole roof, leaving the king post still down about 6 in., and of course the sheets were not free from buckles, and the apple shape was very evident. As had been indicated by appearances, the sheets and joints proved unhurt and tight, not a particle of leakage of air having accompanied the raising of the crown, nor did any subsequent defect in this respect develop itself.

Having thus placed the holder in condition to be repaired, the erection of a temporary scaffold near the sides, and the testing and replacing of the injured parts of the internal framing, was easy. In fact, a complete restoration was made in less than a week afterwards, at a cost of not to exceed $300 for the ironwork, and the holder was ready for use again by the 20th of December, and was in use, on the completion of the tank repairs, shortly after. It would be impossible to find any signs of injury from this accident at this time."

## AUBIN'S IMPROVED FLOUR-MILL.

THE annexed figures represent an improved flour-mill, which has now been used, with excellent results, at the establishment of M. Aubin, at Bouray (Seine-et-Oise), for eight years. The object of M. Aubin's improvements is to separate the bran from the flour more expeditiously and completely than heretofore has been practicable. For this he suppresses one groove out of the two in the lower millstone, replacing it with woven wire. Certain other modifications are also introduced, which will be best understood by reference to the figures. In figs. 1 and 2 M is the runner millstone, and M′ the bedstone; *e e* are the ends of the adjustable flour sieves, clothed with woven wire, regulated with screws to suit the wear and tear of the stone; *o o* a hammer that strikes the ends *e e*, to clear the meshes of the sieves; *d d* cams setting the hammer in motion; *c c c c* cross-bars carrying the cams; *r r* cross-bars carrying a mixing rake delivering the flour by the spout A; *a a*

Fig. 1.

a shaft giving motion through the pulley *t* to the shafts *m m*, carrying the arms aforesaid; V the driving pulley; C D a space between the millstones, whence the bran issues at B; *g* is the wheat-spout, by which the grain is led to the hopper *f*, whence it passes to the grindstone. Fig. 3 represents the woven wire dressing-frames inserted in the bedstone.

One of the most obvious results of the new arrangement, which is applicable to all running millstones, is the possibility of grinding more grain in the same time with the same power. The economy of power appears to be as much as 25 per cent. The flour produced does not traverse more than one-half of the furrows of the bedstone, and leaving the mill as soon as ground, without having to traverse the entire furrow, the flour is actually manufactured by the power that would have been otherwise employed in discharging the flour which passed through the sieves. The reduction in the consumption of fuel, where steam is used, confirms these theoretical deductions. Another advantage of the system is that the flour is not sub-

jected to the heat and pressure which would be necessary under the old system in discharging it from the circumference of the mill-stones, but preserves intact these qualities which hitherto have always suffered from prolonged friction and exposure to a high temperature. Flour thus manufactured produces better and whiter bread. The value of "firsts" is raised about 3 per cent. For producing extra white flour, as required by the Paris bakers, there is a like saving of 25 per cent. over the dressing.

The system has already been adopted at more than one mill in Austria, the proprietors of which bear testimony to its value and efficacy. *Stummer's Ingenieur.*

## THE PRODUCTION OF TRULY CYLINDRIC SURFACES FOR CALENDER OR OTHER ROLLS.

ALL mechanics who have had many years' experience in the workshop have learned that the most accurate result of turning fails to give either parallelism or concentricity to a cylinder. Only a relative perfection of the lathe in all its parts, an almost accidental homogeneity of the material upon which the turning is done, a fortunate endurance of the tool used on the work, and much skill of the workman allows even an approximate cylinder to be made. The admitted conclusion of the mechanic is that following the turning, and after as good work has been done as will proceed from average lathes, tools, and workmen, the rolls must be finished by a grinding process. The method of trueing the surface of a cylinder by grinding wheels (stone or emery) mounted on a carriage travelling on the ways of a lathe, in which lathe the roll is hung, either on centres or on its own bearings, is well known; but this process is so embarrassed by the imperfections of the lathe ways (either original or in wear), by the spring of the roll away from the grinding wheel, and by the necessity of great accuracy in setting the roll parallel with the ways, that the production of a perfect roll becomes almost impossible. After attaining a degree of perfection in this way, the workman has found the grinding of two rolls together, with a slight vibratory motion to one of them, to be the best way to correct the errors of diameter, and straighten their faces. And after all, much labour, skill, and care has failed to satisfy the critical workman, and only produced calender rolls for paper machines that have sufficed for, rather than answered the requirements.

There was shown at the recent exhibition of the Franklin Institute, by J. Morton Poole and Co., of Wilmington, Delaware, a paper calender, having eleven rolls. The rolls were 7 ft. in length, measured on their true faces, the top roll being 12 in., followed by eight rolls of 7 in., one of 12 in., and a bottom roll of 15 in. diameter. These rolls were, all of them, as far as possible callipering and examination would detect, perfectly parallel and concentric, and would bear the exacting test of the perfect visual contact when interchanged.

The machinery for production and finishing these rolls being protected by patents held by Mr. Poole, he has willingly exhibited it, and a brief description of the principle involved, and special apparatus employed, will be of undoubted interest to the readers of the Journal.

Any person wishing to find if a shaft or roll is round or is parallel, would try it with a pair of callipers. This is all that Mr. Poole has done. Only that he has mounted at each toe of the callipers an emery (corundum) wheel, and these wheels grind the spot they touch to the desired uniform calliper. The roll being mounted in a lathe, the calliper wheels, one on each side, are passed down it on the line of the centre, or very close to this line, whilst it revolves.

Any machinist will see that, if the line of the centre of the roll in this supposed case is exactly in the plane of the path of the axis of the grinding wheels, the result, after all requisite grinding is done, must be a perfectly callipered roll; and this is also true if the line of the centre of the roll is parallel to, above or below, the plane of the path of the axes of the grinding wheels. But then this may not, therefore, be a round one. A cardioid or heart-shape cam, or an eccentric will calliper perfectly, and yet not fulfil the requirement of cylindric perfection. Now, if we consider the callipers to hang freely, it is evident that, if they are grinding an eccentric or cardioid shape, they will oscillate to follow the eccentricities. If, therefore, the callipers are held from swinging by friction of sufficient amount to make one of the two wheels do all, or most of, the work, the high place of the eccentric or heart will be reduced first on one side and then on the other, and, when a reduction is once provided for, it is only a question of time when the object will become perfectly round.

The great interest which attaches to Mr. Poole's system of grinding is in the close approximation to mathematical accuracy resulting from it, in the production of original cylinders, cylinders which in no respect follow or repeat inaccuracies of their own, or even of the machine used in finishing them, and so nearly fill the requirements of exactness that eight or ten can be selected from a thousand, and piled into a set ready for use. It is not essential that the finishing (grinding) lathe shall pretend to much accuracy in construction, for it is incomplete unless the roll to be ground is in place. The roll itself forms part of the machine, and its axis of rotation is the real guide for the path of the callipering grinding wheels.

To make this condition better understood, let it be conceived that at any place the callipering wheels are stopped from traversing along the ways of the lathe bed, and operate upon a portion of the roll that is decidedly eccentric from fault in turning. At this point of the roll, the grinding wheels, acting as callipers, will vibrate back and forth (crosswise to the roll), moved by the eccentricity; but, from the resistance to this motion given by clamping them, they will cut hardest on the high sides, and the force required to vibrate the callipers will in time wear down the eccentricity, and a true circle be the result. What has thus occurred at one point on the roll surface will be repeated by traversing the grinding wheel for its entire length, and the finished roll becomes the mere extension of the true circle into a cylinder. Thus the grinding lathe originates an absolute cylindrical form without the aid of straight-edge or guiding former-bar.

The condition of this accurate grinding was stated to be the coincidence or parallelism of the axis of the roll with the plane of the path of the axes of the grinding wheels. If the roll is placed much out of this plane, it will be noticed that the callipers will only measure the diameter at the point where it coincides with the plane, and that anywhere else they measure above or below the centre. If the point of coincidence of diameter be the middle of the roll, the shape resulting is dice-box form (a hyperboloid of revolution), and, in fact, this very shape is produced sometimes intentionally, as in the case of chilled rolls for sheet iron, which require to be a little hollow in the middle to compensate for the greater expansion of that part by the heat when rolling iron. But, if the roll so nearly coincides that the variation of the line of the axis of the roll with the plane of the path of the axes of the wheels (or a plane near to it, but parallel with it) bears but a small proportion to the diameter of the roll, the error in true cylindrical form becomes exceedingly small.[1] If a roll 10 in. in diameter is assumed, and if the grinding wheels be taken to be 8 in. in diameter; and if the roll be placed in the grinding machine 1-10th an inch out of the proper position (supposing in this case the middle of the length of the roll to be in the right plane and the ends 1-20th an inch up and down), the diameter at the end of the roll will exceed that of the middle by 1-6480th of an inch.

Now it is perfectly feasible to set a 10 in. roll within 1-50th of an inch, and the inequalities of the ways of a bed arising from wear ought to be kept within this limit, and, if 8 in. grinding wheels are supposed, the practical accuracy following this setting would be within 1-162,000th of an inch. The sag of a roll (for they are ground in horizontal position) from its weight alone is an estimable quantity, is so small in rolls of ordinary proportions that 1-2,000,000th of an inch would include the error in parallelism proceeding from depression from proper plane in the centre, for a roll 8 ft. in length.

The effect upon the trueness of the cylinder of setting the roll in the grinding machine, out of the line of the ways or path of the callipering wheels, but in the proper plane, is nothing whatever, within large limits of deviation. After the roll is rounded by grinding, it is obvious that it makes no difference how the callipers move, only provided the points of contact with the cylinder be on the diametrical lines; and, even when rounding up with the callipers held by friction from freely placing themselves, the oscillatory movement of the callipers continues so long as any eccentricity exists, after which the calliper movement becomes steady, and the friction resistance transfers the grinding work mainly to one wheel, when the traverse is in one direction, and to the other on the return. It is only necessary that the friction nip should not relieve one wheel entirely,

[1] The error resulting from want of parallelism of axis of roll with the plane of the path of callipering wheels is (neglecting the square of the error as inconsiderable), at any part above or below the normal plane = Twice the { elevation or depression, multiplied by diameter of the roll } square of { divided by the sum of diameters of roll and one wheel } divided by the diameter of the roll.

and it is of course best, after the roll is truly round (a condition easily detected by the marks on the face left by the wheels) to complete the finish of the surface with free callipers.

The small errors indicated as possible to this system of grinding with but a minimum of care in setting can be nearly eradicated by excellence in workmanship, and Mr. Poole does actually work below the limits here stated.[1] Admitting an error of a 50,000th part of an inch to exist, and to be distributed, by a uniform deviation out of plane, into the surface, so as to give the hyperboloid before spoken of; admitting this, the contact of a set of rolls would still be perfect, for the error is far within the elasticity of the material of the roll, so that a set of nine rolls, thus ground, would have line bearings on each other of apparent perfection.

In fact the lower roll of a set in a calender cannot be ground entirely by this system, for it has to carry the weight of the entire set and of itself, and is depressed to a catenary form. The material of these rolls under their own weight can be considered as perfectly elastic, and the pressure will then be that of a fluid of uniform depth upon the string support. It has, therefore, been found necessary to produce a barrel shape roll for the bottom one. The amount of enlargement in the central diameter for a 6 ft. by 14 in. roll is stated by Mr. Poole to be about 1-150th an inch. This roll, therefore, is first trued up round and parallel by the described process, and then is barrel-shaped by the usual one of a "former-bar" guide to oscillate one of the calliper legs. This former is made with perfect accuracy, as compared to one planed up, by using a truly ground cylinder of proper length, which is laid parallel to the roll with the greatest care, and is sprung, by being held at both ends and forced out by a sheet of paper thickness, in the middle of its length. The accurate setting of this "former-bar" is ensured, if the roll is first ground parallel, by the length of the cut of the grinding wheel at each end of the roll—an indication that is measurable, in this case, to a millionth of an inch. The curve derived from this distortion of the former-bar is not exactly that desired, but it approximates to it, and by the condition of nearly perfect elasticity for exceedingly small movement, as has been before stated, the two curves coincide to all needful accuracy.

The grinding machines to operate on this principle present, as made by Mr. Poole, some peculiarities of construction worthy of note; taking, for description, the finishing machine for grinding calender rolls of from 6 in. to 16 in. diameter, and 5 ft. to 8 ft. in length of face. Such a machine consists primarily of a massive bed (and trough for water) much like that for a lathe of 48″ swing. Upon this bed are mounted a driving head, two housings to take the roll necks, and a carriage to travel between the housings and carry the grinding wheels. The driving head is, of course, out of all proportion with that needed for a lathe of similar dimension; and, in fact, the spindle is but 3 in. to 4 in. diameter, and the power is applied by a large overhung pulley without gears. This pulley is some 5 ft. in diameter by 5 in. face, and is driven at about forty revolutions per minute. (Belt power only answers to give that uniformity of motion to the roll which will produce a smoothly marked surface, for the best of cut gears leave their impression on the finished roll.) Under the spindle is placed a reversing screw gear for actuating the carriage. The mechanic will need no description of this attachment, only to say that the feed is about 3-16ths an inch, and that the screw is properly shielded from drippings. The housings with their adjustments for bearings for the necks also do not call for description to be understood by the practical man. The carriage, with what we have called the callipers, need a fuller explanation. The carriage is like that upon any lathe bed, up to the bottom of the tool post slides, but it has four posts or horns cast upon and forming part of it at the front and back corners. These posts are perhaps 12 in. apart, along the carriages, and 3 ft. apart across it, they are T shape with the flat of the T's towards each other, and they are not capped, but the top ends are open. They are about 18 in. high. Fitted between the posts, a loose sliding fit, is placed a substantial double-ended cross slide rest, which hangs, by links or knife edges, from the upper end of the posts or horns, and is free to swing from side to side across the lathe. Upon this cross slide rest at either end is mounted like tool posts, two boxes which contain the grinding wheels. Everything about this part is solid and substantial, and this arrangement forms the calliper we have so often referred to. The calliper will thus be seen to be applied from below upwards; the friction which prevents oscillation is obtained by a set screw in one horn which bears on a spring washer, and thus effects the nip.

The grinding wheels used are a special make, none having been found on sale that would fill the demand of durability so as not to wear appreciably in one travel of the carriage, and also of capability to be run with water, it being, as is well known to all grinders, impossible to get true work from a stone unless water is used freely to preserve the temperature. Corundum has proved most suitable, and the wheel-making part of Mr. Poole's establishment is by no means the least important, either in expenditure or appliances. The wheels are, when new, about 9 in. in diameter by 1½ in. thick; they are mounted on heavy spindles with conical bearings, and have pulleys to drive them, on both sides of the wheels, about 4 in. diameter by 2 in. wide. Great care is taken to balance each part of the body in rotation, separately and together, so as to get out the least jump of the grinding wheel.

The grinding wheels run with about the circumferential speed of a mile per minute. The actual reduction of a cylinder due to one pass or traverse of a pair of grinding wheels, as determined by many experiments, does not vary much from 1-20,000th of an inch (= 1-40,000th at each side). They are driven by two overhead drums, one below the other, the upper one 18 in. diameter, and the lower one 15 in. in diameter. These drums are 8 ft. or 9 ft. in length, so that the belts can traverse up and down with the carriage. They are made from sheet tin, like some of the cylinders of a paper machine, and are carefully balanced at every point of their length so as to be in equilibrium of rotation. The disposition of each belt is as follows: the slack side of the belt passes down from the top drum, under the spindle pulley of wheel on front of machine, then, being drawn up over the lower drum, it is passed down from the lower drum under the spindle pulley of wheel at back of machine, and, finally, it is a second time drawn up over the top drum to the place of beginning. The tension of a vertical belt depends upon the elasticity either of the belt, or of the shafting, and it is found necessary to drive the two drums in such way that the surface speed of the top drum shall be just enough less than that of lower drum, as will compensate for the stretch of the belt, and avoid throwing all the slackness into the down side of the belt from the top drum, in order to ensure proper adhesion to the pulley of the first spindle. By this double loop arrangement of belts the work is accomplished by two belts in place of four, and the contact of the belt with the spindle pulley is made 180° without using a cross belt. A cross belt is undesirable for a travelling one.

It will be noticed that the tension of the belts tends to lift the carriage off its links and knife edges, but the weight of the carriage, with the wheels, spindles, &c., is so large as to resist this strain, and also to avoid any unsteadiness therefrom.

The arrangement of counter-shafting for driving the machine and the drums does not call for description. A copious supply of water is fed upon the roll while the grinding proceeds; this water is pumped up to a tank by a pump attached to the machine, and, as the same water is used over and over, the fine corundum in suspension adds materially to the cutting effect of the wheels.

Calender rolls of greatest excellence are an American product, and depend upon our grade of gun iron produced from charcoal pig of Connecticut origin for the best, but it is probable that the product of a Siemens-Martin furnace, or possibly Bessemer material will eventually allow other iron to be used. They (the calender rolls) are now produced chilled to moderate hardness (the superlatively hard chill is blowy) with absolute perfection, without a pin-hole or blemish on an entire roll surface.

In turning of these rolls exceedingly strong lathes of ordinary form are used to cut off the rising head, and true up the necks, and they are faced up in the roll lathe (of the rolling mill), which differs materially from the machinist's slide rest lathe. Both the necking and roll lathes of Mr. Poole present many features of specific excellence and novelty; but the length of this paper will not permit more than this allusion to them, except that it is proper to mention that the tool used in the roll lathe in cutting chilled iron is a flat bar of planed steel about 3½ in. wide by 1¼ in. thick, and in lengths of from 4 in. to 10 in. The cutting edge is formed on four corners of two sides in this way: a groove ½ in. in width by ⅛ in. deep, is planed along the side in the middle of the thickness, and the edge, thus relieved in the centre, is ground in an ordinary parallel grinding lathe by a 6 in. wheel, to the shape or concavity of the grinding wheel. This procedure gives a cutting edge of 78°, and has been found

[1] While it is so easy for a tolerably skilful workman to set the axis of the roll in parallelism with the plane of grinding wheels, it is possible to arrange the machine so that even this care of setting may not be demanded. If, in place of hanging the grinding carriage, at both ends, from the horns of the travelling carriage, it should be hung from one end only, while the other end depends from an arm which runs or passes over the roll, and rides upon it, by a wheel (or slide), the grinding will then be done *altogether* independent of the ways of the lathe. This arrangement will therefore compensate of itself for all errors of setting, or wear or inaccuracy of ways. In such case the riding wheel (when one is used) must necessarily be very true, for the attainment of absolute perfection.

Fig. 1.

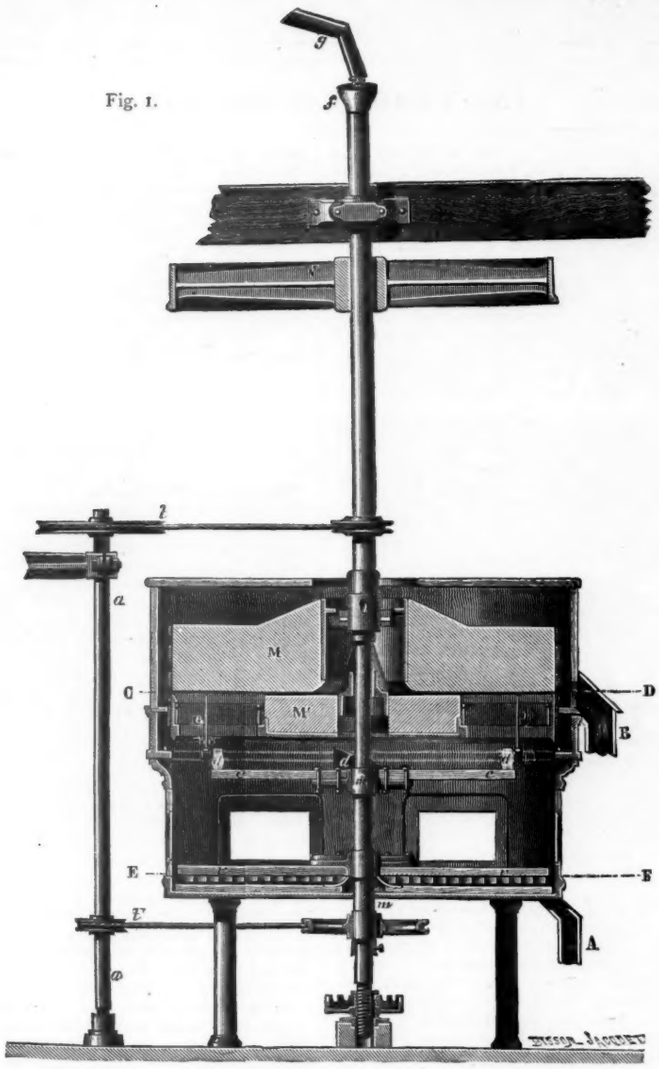
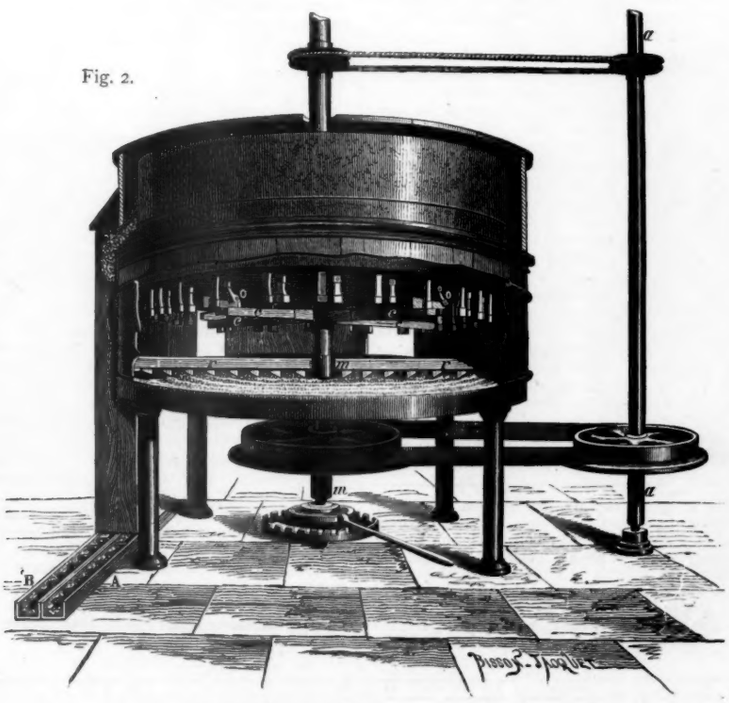



Fig. 2.




AUBIN'S IMPROVED FLOUR-MILL.

(*For description see p.* 6.)

by Mr. Poole to answer perfectly, when used in the roll lathe method of crowding up to the cut. It is, however, admitted that no steel is good enough, or can be made hard enough, to be so perfectly satisfactory that nothing better could be wished.

Before commencing to grind the surface of a roll, it is indispensable that the necks shall be true and round. Exact parallelism is not requisite, but the first step in roll grinding is to grind the necks on dead centres to positive roundness. Except this is done, the calliper grinding of the bodies only reproduces all the eccentricities in the necks. When this precaution is neglected, the rolls will fail to drive each other without being geared together. The test of accuracy, or rather of freedom from eccentricity, is the absence from tremor when the "stack" of rolls is running. When perfect, not the slightest vibration can be felt.

It has been stated that the action of the grinding wheels was determined to be 1-20,000th of an inch for both wheels (1-40,000th each). With this rate of grinding, a chilled roll of American hardness, 12 in. in diameter and 72 in. face, turned in Mr. Poole's roll lathes, with the bearings ground beforehand on centres, can be finished in seven and a half hours. To effect this, the turning must have been exceedingly accurate, and no error of callipering in the lathe, or of eccentricity proceeding from inequality of hardness of chilled surface (or more generally from spring of the roll in cooling, which may demand a strong cut on one side, and a very light cut on the other), greater than 1-500th or 1-600th of an inch, must exist prior to the grinding.

[1] An idea of the minuteness of the error which will prevent continuous contact of any two rolls can be entertained by referring again to the work of one grinding wheel, on one pass or traverse, equalling 1-40,000th of an inch. Arrest one of these wheels anywhere in the length of a roll, and prevent it from taking its 40,000th of an inch from the cylinder, and the defect becomes manifest when two rolls are placed in contact, not by passages of light, but by the break in the continuity of the burnished line made by sliding one roll upon the other. When two cylinders of iron are placed together, it is just possible to detect by the eye an opening of 1-4000th part of an inch, and this minute opening separates the light into its prismatic colours. The linear contact test, therefore, becomes ten times as perfect as the visual one.

As an example of the degree of accuracy attained by this new method of grinding, the experience of Mr. Poole's machine in Wurtemburg can be cited. The government of Wurtemburg is of itself the proprietor and operator of the larger manufacturing industries (which are generally carried on by companies elsewhere), such as mining, iron and metal works, machine shops, paper making, &c., &c., and became a purchaser of Mr. Poole's patents for the kingdom. Among the stipulations was one founded on the statement as to time (7½ hours) required to grind a 12" × 72" roll, which was made a condition of performance obligatory on Mr. Poole, under penalty of forfeiture of agreement. This was easily accomplished, however, as the Wurtemburg chilled roll for the test, from the nature of the iron, proved softer than any American one, and was turned to greater accuracy than can be reached with more intractable material, and but 3½ hours were needed to effect the desired grinding.

But a more satisfactory exhibition of the excellence of the new process was afforded when a roll previously finished in the same workshop was tested in the new grinding machine. This roll had been an especial effort, having been finished for the Vienna Exhibition, ground and polished to the highest brilliancy, and had come back from the exhibition with an award. It was found so tapering and generally imperfect as to require and occupy two days' grinding to bring it to cylindrical form.

In 1868, when this method of grinding rolls was first introduced, there is said to have existed in all the paper mills of the United States but two "stacks" of chilled rolls; or, at least, Mr. Poole avers that he only knows of that number. These stacks were five rolls high, and the rolls were short, 48 in. and 62 in. faces respectively. Chilled rolls were, however, commonly in use at that time, as super-calenders in writing paper mills, say from 24 in. to 30 in. face. No maker of paper machinery had ventured to make chilled rolls, for machine calenders of 72 in. to 84 in. face, which has been demanded to meet the requirements of width, of the common Fourdrinier machines. The stack shown at the exhibition of the Franklin Institute was 11 rolls high, with 84 in. face, and is not an uncommon stack at this time. The great superiority of calendered paper, and of paper calendered by perfect rolls—in freedom from buckles; mottled, dead and bright places; and in parallelism of the sheet—has led to a rapid increase of calenders, both in this country and abroad. And an actual improvement in the manufacture of paper has been effected.

The several results can be summed up: the accomplishment of mechanical accuracy on philosophical and theoretical bases; the construction of machinery by economical and thoroughly practical process; and the consequent advancement of one of the greatest industries of civilization, the manufacture of paper.

[1] The remarks in this paragraph are Mr. Poole's own comments, and are the undoubted result of practical test within limits of observation. The most perfect of ground polished or burnished iron surface fail to satisfy a microscope of quite low degree. The test for light was not made in a dark room, the reflection on the cylindrical surfaces brought in interferences of much complication, and the high elasticity of iron under small loads or in almost differential compression, would limit all these tests to the usual condition of *approximate accuracy*.

## FLANGED PULLEYS.

THE following is quoted from the "Journal of the Franklin Institute:"—

There are some places where the use of flanged sides to retain the belt upon the faces of pulleys is desirable, if not essential. Thus, for driving a ball governor, which requires no power whatever when in motion at uniform speed, but demands an application of force sufficient to lift the balls from their position of rest into their place of rotation in the very short interval of time of starting an engine (which starting is generally without work upon the engine), flange pulleys are almost essential to keep the belt from sliding off the edge of one or the other of the pair of pulleys. For tightners on some classes of machines, and for mule pulleys, the same necessity exists. In such cases most machinists have, however, encountered the difficulty—especially with long belts—arising from the belt riding upon the flange or its side, and, if not running off altogether, of stretching the edge in places, and thus destroying the belt rapidly.

By giving the flange the correct shape indicated in the figure, it will be found possible to avoid any of these accidents, and that flanged pulleys will become as serviceable as any others. The shape to be given is simply that obtained by cutting away the base of flange (as at A A) and allowing the edge of the belt to come in contact with the outer periphery only. Pulleys thus formed present to the unaccustomed eye of a machinist a somewhat strange look, and, except the reason were explained, he would think some bad workmanship had cut away the fillet at the base of the flange improperly. But the fact is positive, and the eye soon appreciates any such essential feature. It may be added that long belts, whether on flanged or plain-faced pulleys, had best be crossed for regularity of velocity and quantity of power to be imparted by them, as well as for durability.

## AIR COMPRESSORS.

WE are indebted to the "Revue Industrielle" for the accompanying figures and details of improved air-compressing apparatus, constructed by the well-known Parisian firm of Sautter, Lemonnier and Co., from the designs of Professor Colladen, of Geneva, the consulting engineer of the St. Gothard enterprise.

The compression of air, no matter how effected, is always attended by an evolution of heat, which raises the temperature of the air under pressure to a degree proportionate to the pressure exerted, and communicates itself to the surrounding material. Each stroke of the piston develops a further quantum of heat; and it is quite possible that, unless some means of refrigeration were provided, the temperature might rise to a degree sufficient to weaken or destroy the inclosing materials. Besides this, the tendency of the heated air to expand produces a negative effect, resulting in loss of power and increased cost of compression.

The earlier makers of air-compressing machinery considered the intervention of a column of fluid moving at low speed as the only practical solution of the difficulty. This was the principle of the air-compressors used in the Mont Cenis tunnel, and it is not yet quite abandoned. Its chief drawback is that low rates of speed are necessary, and it does not, therefore, provide for certain accelerations, which may prove necessary where the

Fig. 2.

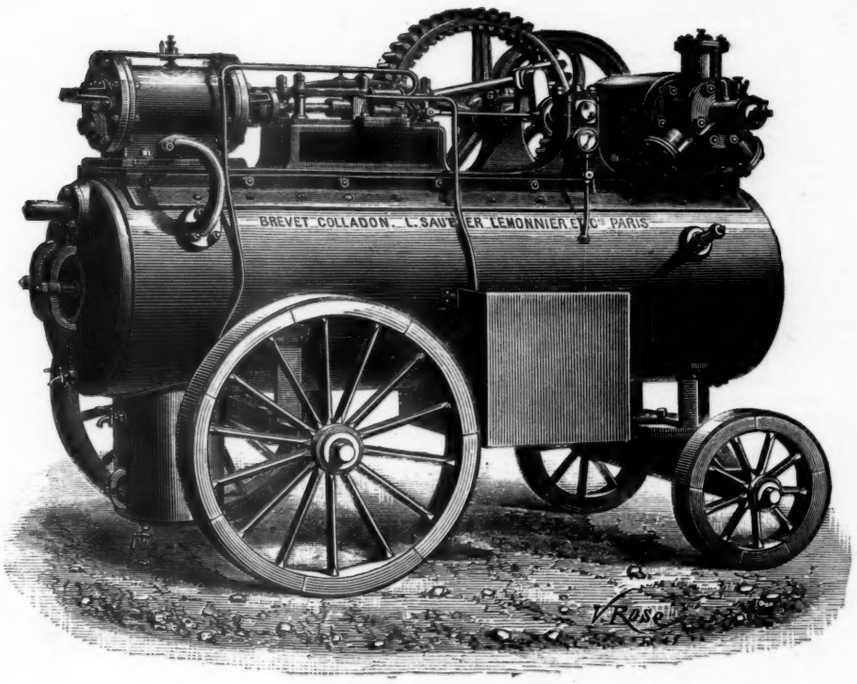



Fig. 3.

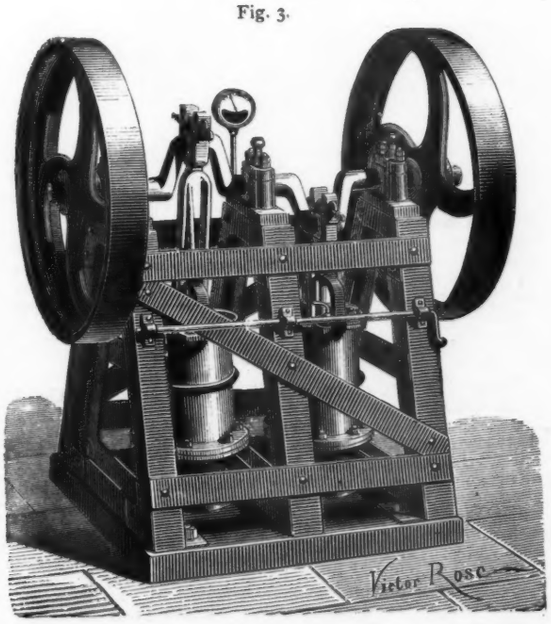
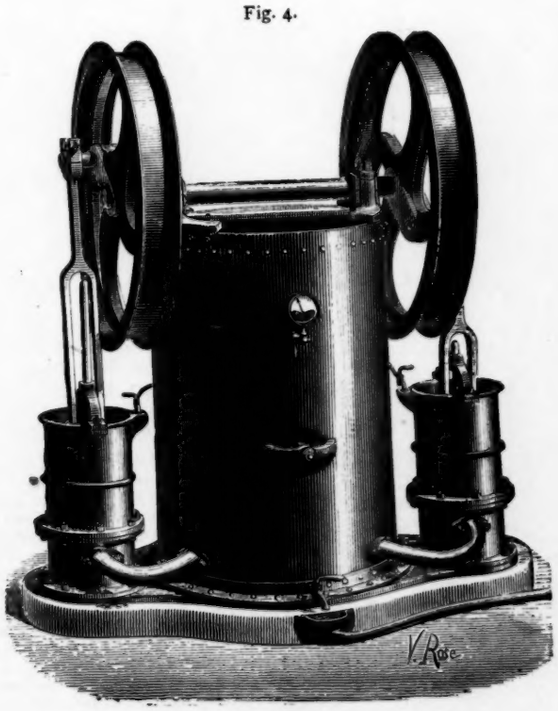



Fig. 4.




SAUTTER, LEMONNIER AND CO.'S AIR COMPRESSORS.

consumption of air is variable. The apparatus is, moreover, costly and cumbersome. Professor Colladen was the first to propose the adoption of high-speed compressors, where every portion of the apparatus in juxtaposition with air is kept cool by contact with a continuous current of cold water, which is also injected in the form of spray into the cylinder during compression, so as to reduce the temperature of the air. An ingenious arrangement of valves and of the circulatory apparatus has allowed of the realization of this idea, which has been adopted on a very large scale at the St. Gothard works.

It is now established beyond dispute that air may be compressed up to 8 effective kilogrammes, with an average speed of piston of 1·50 metre per second, which speed may be increased to 2·25 metres per second without inconvenience, so that a machine intended to give a normal speed of 1·50 metres may be worked up to half as much again without risk. On the other hand, if the dimensions of the fly-wheel are such that the dead-points are just cleared with a speed of 0·75 metre, the limits within which the machine may be worked, according to the demand made upon it, may readily be computed.

The conditions of speed in Colladen's air-compressors are in fact identical with those of ordinary steam-meters. From this results another advantage. An air-compressor on this principle may be worked in connection with a horizontal steam-engine by a simple extension of the piston-rod, without the intervention of connecting-rods, cranks, wheels, or other appliances, which involve extra cost and a certain loss of power in working.

Fig. 1 shows the arrangement adopted by MM. Sautter, Lemonnier and Co. for their largest-sized compressors. The meter and compressor are mounted on the same bed, and these piston-rods are conterminous, being united by a coupling-box, but otherwise separate and distinct, and if necessary may be of different patterns.

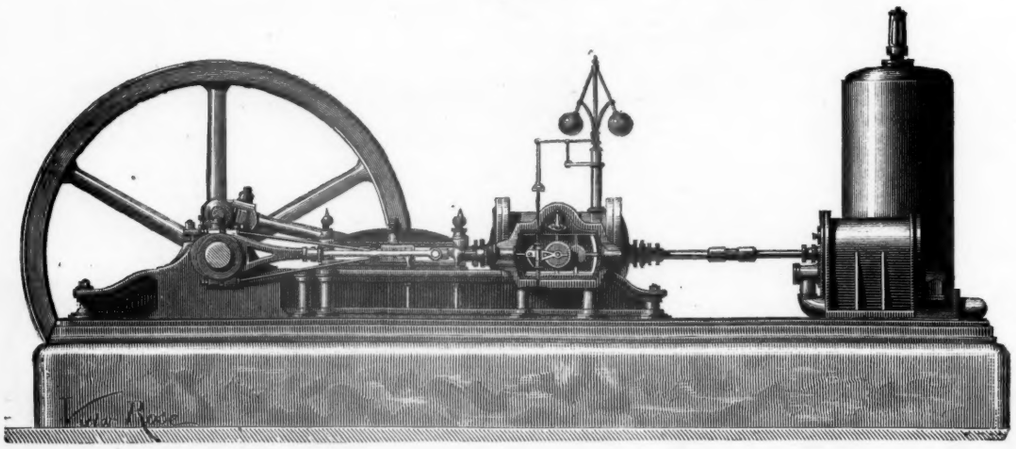
Fig. 2 represents a locomotive, double-acting compressor, constructed by the same firm for the Canada Steel Company. It is worked by a Brotherwood engine, with three cylinders, of 15-horse power. It discharges 500 litres of compressed air, of an average pressure of 8 effective kilogrammes per minute, giving a working power equivalent to 9-horse power, and sufficing to drive two average-sized power-jumpers, at the rate of 400 to 500 blows per minute. The weight is 2¾ tons, and the price 6,500 fr. (£267).

Fig. 3 represents a single-action compressor constructed for the Antiquoin Gold Mining Company in South America. These mines being only accessible to mules, it was an indispensable condition that no single portion of the apparatus should weigh over 2¼ cwt.

Fig. 4 is a similar compressor, with the pump placed directly over the air-chamber—a preferable arrangement where weight is not a consideration.

Both of these compressors deliver the same amount of air per minute as the locomotive represented in fig. 2. They are driven by belting. They cost 3,000 fr. (£125) apiece. MM. Sautter, Lemonnier and Co. also construct smaller compressors, on Colladen's principle, for pile-driving, and for compressing carburetted hydrogen gas for the illumination of railway carriages.

Fig. 1.



## *Chemistry applied to the Arts, Manufactures, &c.*

ABSTRACTS FROM FOREIGN PERIODICALS, TRANSACTIONS OF SOCIETIES, ETC.

### § 1. *Acids, Alkalies, and Salts.*

**HÆMATINE.**—This deep red glass flux, which is often found in ancient mosaic work, has for some time been studied by PETTENKOFER, who has given a prescription for its production as follows: Melt crystal glass with about 9 per cent. of oxide of copper, and a combination of oxide and protoxide of iron as a reducing agent. But the reducing property of the combination of oxide and protoxide of iron extends in this case almost always, not only over the oxide of copper, but also more or less to the oxide of lead in the crystal glass, and from the separation of the metallic lead, which, like the copper, remains suspended in very minute division in the substance of the glass, arises a dark brownish or blackish colouring of the glass. If borax is used as the fusing agent, then, according to Dr. KAYSER, this unfavourable result is prevented, and a beautiful deep red-coloured product is always obtained under suitable circumstances, among which are a high temperature during the melting process and reduction, and then a moderate heat till the dark red glow is obtained, in which the substance is kept for some time. For this purpose a closed crucible is used, with loose cover lying on it. After the extract a deep red glass flux is obtained, which is mostly covered with a thin layer of green oxide of copper and glass in combination. The following prescription has been found most suitable for the purpose: 60 parts of pure quartz sand, 10 of oxide of copper, 3 of a combination of oxide and protoxide of iron, 10 of calcined borax, and 10 of calcined soda. *Bayerisches Industrie-und-Gewerbe Blatt, Oct.* 1875.

### § 2. *Metallurgy.*

**New Method of recovering every trace of Gold and Silver left behind in Electro-Gilding and Silvering.**—Since gilding by the galvanic process has been everywhere introduced into art and industry, a necessity has arisen for discovering a suitable method of recovering all trace of the gold and silver remaining in the superfluous gilding and silvering materials. As in electro-gilding bi-cyanites are invariably used, but this cannot be reduced either by treating it with sulphuric acid gas, or by boiling it with a strong electro-positive metal, as zinc, &c., it has been customary for twenty-eight years past to employ a method introduced by Professor BÖTTGER, which, though effectual, appeared to many metallurgists rather too tedious and complicated. It required that the superfluous materials, which were often in considerable quantity, should be evaporated to dryness, that the residuum salt should be mixed with an equal volume of litharge, and the whole ex-

posed to a strong red heat in a covered crucible. By this means a deposit of gold was obtained, which, heated with warm nitric acid, left behind the gold in the form of a yellowish brown, loose, spongy substance. Certain as this method was to attain the object in view, it still appeared to many too complicated, and consequently the professor undertook experiments for the purpose of discovering a simpler process, and he proposes the following as leaving nothing to be desired :—

Put the superfluous materials, whatever be the quantity, in porcelain vessels for boiling, then mix them with a solution of protoxide of tin and soda, and keep them boiling till all the gold is separated in combination with the tin, as a very dark-coloured precipitate. This precipitate should be sweetened a little, and dissolved in *aqua fortis*. The resulting substance consists of a mixture of chloride of gold and chloride of tin. Let this be carefully evaporated, diluted with distilled water, and mixed with a sufficient quantity of acidulated potash and soda, and the whole warmed. Then every trace of gold is separated in the form of a very fine brownish dust, while the tin remains behind. In cyanites containing silver, every trace of silver may be separated by simply boiling with the addition of protoxide of tin and soda. *Polyt. Notizblatt.*

**Gold Lac for Metal Wares.**—A gold lac, remarkable for its great hardness and beautiful colour, on being analyzed by Dr. R. KAYSER at Nürnberg, gave as its constituents picric acid and boracic acid. Thereupon a clear shell-lac solution was mixed with picric acid and about half per cent. of crystallized boracic acid, each being previously dissolved in alcohol, and the resulting lac possessed all the advantages of the former one. *Bayerisches Industrie-und-Gewerbe Blatt, Oct.* 1875.

**Air Passages of Phosphor-Bronze for Blast Furnaces.**—Ever since 1869 Herr BÜTTGENBACH has made experiments with a view to construct air-passages for blast furnaces in such a way as to prevent the formation of cinder-crust at the mouth, which renders it necessary to destroy part of the brickwork for the purpose of cleaning or renewal. With the ordinary bronze air-passages he has been obliged to have this done as often as every six months. As phosphor-bronze possesses considerable thickness and toughness, and consequently offers powerful resistance to change of temperature and the operation of the fused mass in the furnace, the incrustations formed by water do not adhere so firmly to this metal as to bronze, and, moreover, what is still more important, the former deposit oxidizes much slower than the latter. After a year's use an air-passage of phosphor-bronze will be made as bright as it was at first by being simply rubbed with a rag, and show no sign of incrustation. *Stummer's Ingenieur, Dec.* 3, 1875.

**Ferro-Tungstein.**—Tungstein, or tungstate of lime, imparts great hardness and tenacity to puddled steel. With less than 3 per cent. of tungstein, steel can be forged, rendered suitable for welding, and made into tires of wheels, files, saws, &c. Ferro-tungstein, containing 30 to 50 per cent. of the latter metal, is introduced in small portions at very short intervals during the puddling. Bessemer and cast steel is much improved by the addition of 40 to 50 per cent. of tungstein, which costs 8 francs per kilogramme, so that the ferro-tungstein, containing 40 per cent. of it, costs 3·2 francs per kilogramme. *Revue Industrielle, Dec.* 15, 1875.

**Nickelization by Electrotyping.**—Great progress in nickelization has been made in Paris, where not only bronze and other metallic fancy articles, but also articles of domestic use, such as cooking utensils, are nickelized, and thus greatly improved in appearance, durability, and convenience for use. The best method of nickelizing is the following :—Dissolve four parts of a combination of nitric acid and protoxide of nickel in four parts of liquid ammonia, and 150 parts of water, in which 50 parts of sulphide of iron have been previously dissolved. Under the action of a very weak galvanic current the operation is completed in a few minutes. There is no necessity for interrupting it by taking out and brushing the articles, and, when the metallic coating is thick enough, nothing more remains to be done than to dry the articles by rubbing them with sawdust, after which they will look beautiful and almost as bright as silver. *Bayerisches Industrie-und-Gewerbe Blatt, Sept.* 1875.

**Examples of the contemporaneous formation of Iron Pyrites.**—In making a boring for water, just as the workman reached the source, they brought up some small pebbles and grains of quartz surrounded with iron pyrites. This substance adhered to their surface, sometimes as a yellow, shining, amorphous plaster, sometimes as a crystalline incrustation, in which many triangular faces were observed. It is evident that this pyrites is of contemporary formation, because it is attached exactly in the same way to some flints, cut in the shape of a knife by the hand of man, which were found at the bottom of the Roman draining well, with other antiquities. Moreover, on attentively examining the tiles of a Roman mosaic pavement at the bottom of a canal of mineral water, M. Daubrée also discovered the presence of pyrites. The pyrites of contemporary formation that is observed in some places is generally attached as amorphous plaster. That which has just been found at Bourbonne, in different parts of the subsoil, is distinguished by a crystallized condition. As to the pyrites of the pavement, its dissemination in limestone resembles the way in which this mineral is found in limestones of various ages, *i. e.* those of the carboniferous period, or the Jura limestone, in alumiferous schists, or in the combustibles themselves. This pyrites has recently been met with in the interior of a piece of timber of the royal yacht "Osborne." *Les Mondes, Dec.* 2, 1875.

**Tinning of Brazen Articles.**—Nearly all the known receipts for plating brazen articles with tin are attended with the inconvenience of not giving the proportions of the substances to be employed for this operation. If, as is commonly done, very concentrated solutions are employed, tinning is not produced. If they are too diluted, the tinning is slight. Numerous experiments have proved that the following formula produces excellent results : Dissolve 10 grammes (about 6½ dwts.) of tartaric acid in a litre (about 1¾ pint) of very soft or distilled water; boil this solution, plunge in it the articles to be tinned, and add 10 grammes (about 6½ dwts.) of fine granulated zinc. This granulated zinc may be easily prepared by shaking fused zinc in a box coated with chalk. Then care must be taken to turn the articles to be tinned several times, and replace the water which evaporates. At the expiration of a short time the tinning commences, and the articles in the bath must be continually turned over till the required degree of tinning has been obtained. *Le Technologiste, Nov.* 1875.

**Iron in Russia.**—The principal iron mines in the Russian empire are situated in Finland, the Ural Mountains, Poland, and the southern territory. Deposits of iron are found, not only in mines, but also in the lakes of Finland and Volhynia. The mineral is mixed with organic substances, sand, and clay. The complete absence of phosphoric acid increases its value. In 1873 there were 332 blast furnaces, which produced 336,430 tons of pig iron, 260,939 tons of manufactured iron, and 8,188 tons of steel. *Moniteur Industriel Belge, Dec.* 10, 1875.

## § 3. *Dyeing, Calico Printing, Bleaching, Tanning, and Allied Subjects.*

**Method of Cleaning Wool and Woollen Cloths from Vegetable Materials.**—M. E. LIX, of Alsace, has invented the following process for removing thistles, burs, and other vegetable substances from wool, and also from fulled or unfulled cloth manufactured from such impure wool. The chief value of the process consists in getting rid of the vegetable substances easily and conveniently, without impairing the stoutness of the cloth or wool, or diminishing its softness. The process also does not interfere with dyeing and fulling, since the wool and cloth can be dyed and fulled after it just as well as usual. It is as follows :—

The wool or cloth to be purified is put into a bath of sulphuric acid of three to six degrees' acidity, to which, according to the nature of the cloth, a certain quantity of alum, salt, and borax is added. Generally for 22 gallons of diluted acid a pound of alum, half a pound of salt, and a pound and three quarters of borax will be sufficient. The wool or cloth is reeled in this bath from one to two hours, afterwards spread out by means of a centrifugal apparatus, and then subjected to a heat of from 212° Fahr. to 248°. The subsequent removal of the acid is one of the most important operations, and must be executed with great care and completeness, otherwise the quality of the goods will be injured. The complete removal of the acid is accomplished thus :—First the wool or cloth is washed for an hour and a half in fresh water, then for two hours treated with fuller's earth, soda, and potash, and, lastly, again washed for two hours in fresh water. In this way all trace of the acid will be removed.

Sulphuric acid, however, can be used only with white or indigo-dyed cloth. To act upon dyed wool, and woollens dyed in the piece, for a similar purpose, without effecting the colour, Lix employs chloride of zinc and chloride of manganese, diluted to six degrees, and proceeds in the same way as with sulphuric acid, adding alum, salt, and borax.

It is to be observed, also, that the stripes of cloth, being generally cotton and consequently of vegetable material, are liable to be injured by the acid, and should, therefore, after leaving the centrifugal apparatus, be stroked with a dough of

syruppy consistence, composed of fuller's earth and equal parts of soda and sal-ammoniac. By this means the stripes will be deprived of the acid, and prevented from turning black. *Bayerisches Industrie-und-Gewerbe Blatt.*

**Manufacture of Guignet Green on a large Scale.**—This beautiful colour, which in its tint and brightness rivals *Schweinfurt* green, and has the great advantage over it of being free from poison, is, as is well known, a hydrated oxide of chromium, produced in a peculiar manner. It may be easily prepared in large quantities by melting together to a dull red heat a mixture of three parts of boracic acid and one of bichromate of potash on the hearth of a reverberatory furnace constructed for this purpose. The mass swells up, disengages oxygen in abundance, and ultimately changes into a beautiful green combination of borate of chromium and potash. Successive washings with boiling water separate it into hydrated oxide of chromium and soluble borate of soda. When the washing is over it is bruised fine, and a colour is obtained of the most beautiful tint, which covers well, resists the air and light, and is affected only by concentrated boiling acids. It may be easily prepared in small quantities in a porcelain crucible. *Technologiste.*

**Chromate of Iron.**—If to a solution of neutral chromate of lead be added a solution of chloride of iron sharpened with hydrochloric acid, a dusty precipitate is formed of a bright orange colour. This is chromate of iron, which, dried at 104° Fah., is found to be composed of 65 to 65·11 per cent. of chromic acid and 34·58 to 34·71 of oxide of iron, a composition represented by the formula $(Cn.\ O^4)^9\ Fe^2$, and corresponding mathematically to 65·33 of chromic acid with 34·66 of oxide of iron.

This chromate of iron is insoluble in water, easily soluble in hydrochloric, nitric, and sulphuric acids, and decomposes when it is digested in a ley of soda. When strongly heated, it swells and changes to a blackish brown.

Chromate of iron may be conveniently used for oil-painting, for, though in vivacity of colour it is not equal to chromate of lead, it has the advantage over it of not blackening under the action of hydro-sulphuric acid, and being in all circumstances without injurious effect on the health. Lastly, chromate of iron may be obtained at a much lower price than chromate of lead. *Technologiste.*

**Sand's Leather-Blacking.**—This well-known useful blacking for leather may be made thus: Dissolve 11 lbs. of green vitriol and 5 lbs. of tartaric acid in 9 gallons of water. After the settling, draw off the clear liquid; then boil 16 lbs. of logwood with about 18 gallons of water and 11 gallons of the fluid. Let the boiled mixture stand for about eight days, pour it off from the sediment, dissolve in it 2 lbs. of grape sugar, and mix this liquid with the green vitriol solution. The blacking so obtained may be made still brighter by mixing the logwood decoction with 4 lbs. of aniline black-blue before the addition of the vitriol. The application of the blacking is very simple. The leather is first well brushed with a solution of soda, or still better with spirit of sal-ammoniac, in twenty-five times as much water, to get rid of the grease. The blacking is then applied with the proper brush for the purpose. *Stummer's Ingenieur, Dec.* 17, 1875.

**Eosine a Substitute for Litmus.**—MEISTER recommends the brilliant new dye, eosine (see "Practical Magazine," August, 1875), as a substitute for litmus in testing for alkali. Eosine changes instantaneously when exposed to the slightest alkaline action, whereas the change of colour in litmus is progressive. *Moniteur Indust. Belge, 1st Nov.* 1875.

### § 4. *Food, Water, and Sanitary Matters.*

**The Preservation of Eggs.**—The following method of preserving eggs has been discovered by M. DURAND of Blois. In an earthen vessel put a solution of silicate of potash, diluted with water to about 25 or 30 degrees of acidity by the gauge. As the solution has a tendency to get concentrated by evaporation, it is advisable to add a little water from time to time. The eggs, quite new-laid, are to be put in the vessel for a few moments, and then withdrawn one by one. This is the whole of the process.

A slight difficulty, however, presents itself. The sticky liquid of the silicate runs down to the lower parts of the egg, and there forms a drop which sticks it so fast to the board, that it cannot be disengaged without often breaking. To avoid this inconvenience, nothing more is required than to put the eggs on a sheet of paper, which is afterwards torn off. The drying of the silicate does not take more than twenty-four hours.

Eggs thus prepared one day are ready to be stored the next, and will keep as fresh as at first for a whole year, because the silicate stops up the pores of the shell, and prevents the access of air. *Le Technologiste.*

**Preservation of Raw Meat.**—M. HERZEN, of Florence, has for a long time been engaged in trying to discover a means of preserving raw meat, and has met with great success. He makes use of crude boracic acid, which, by the addition of borax, is rendered more soluble through the formation of a very acid salt. The effect of this solution is increased by the addition of some common salt and saltpetre, and in this way the fresh appearance of the meat is maintained. Various opportunities of testing the method for months during the heat of last summer were turned to account, and several persons lived for a month in the hottest season on meat thus prepared and preserved. The meat retains its natural appearance, shows no trace of putridity, and even microscopic examination detects no change in it. The last remnants of a larger quantity which had been packed in chests and leaden boxes without any special care, and had gone two tropical voyages, was still eatable after about a year. M. Herzen's plan may be considered as a solution of this problem, which possesses an interest both for chemists and the public generally, now that meat is so dear. It is stated that a company has been formed for bringing meat preserved by this process from South America and Russia. *Report of the German Chemical Society*, 1875.

**Sub-Cutaneous Injections of Distilled or Pure Water.**—Water injections are useful whenever it is desirable to subdue any pain, and are never injurious. The operation is the same as that employed in all ordinary sub-cutaneous injections. They ought to be made at the painful part, and never consist of less than 2 grammes (about 31 grains troy), or more than 10 to 12 grammes (about 154 to 185 grains). *Les Mondes, Nov.* 18, 1875.

**Simple Method of Keeping Meat.**—It is almost impossible to keep meat good, even for a few days, in hot weather, without costly apparatus, especially if there is no deep cellar at hand. The following plan, which has the advantage of being simple and cheap, may be found useful. Cover the bottom of a pan or pot, which narrows downwards, with strong vinegar, and over this place a sieve, on which the meat may be put. Then carefully close the cover of the vessel, and the meat will be found good after a considerable time. *Neue Deutsche Gewerbe-Zeitung.*

**Bread Making in the United States.**—In the United States bread is nowhere made with yeast, and yet it is in every respect better than ours. To make the leaven they take a handful of fresh hops and about a quart of water, which they boil together, and then pour over a cloth. In large bake-houses this solution is immediately mixed with the flour which is to be kneaded. This is sufficient for 11 lbs., to which is added warm water enough to produce a paste of the desired consistence. In households the solution of hops is kneaded with sufficient flour or potato starch to make a thick paste, which only requires drying with a gentle heat in the oven or on a stove. When dry it is pounded and kept for any length of time in paper bags hung from the ceiling of a very dry room.

When they wish to make bread, they mix a handful of leaven in water, then add five handfuls of flour, and enough water to make a clear paste, and put the mixture in a deep earthenware jar, which is placed in the evening on the stove. Fermentation immediately begins, the paste swells and rises much. The next morning the leaven thus prepared is mixed with 11 lbs. of flour, salt, and water enough to produce the kind of bread that is wanted. The more water they put, the better the bread rises, but then the bread is so liquid that they are obliged to put it in iron vessels, which must be only half filled, because the paste swells so much in the baking.

The hop solution acts on the flour exactly in the same way as yeast, but with such force that its action is instantaneous. Consequently, there is in the hops an alcoholic fermenting agent far more powerful than that in the yeast. This fermenting substance is soluble in water, and resists the action of boiling water. It is more than probable that the infusion of hops, hitherto prescribed for invalids as a tonic, acts only as a digestive, and will be generally employed for persons of weak digestion. *Paper by M. Sace, communicated to the Academy of Sciences.*

**The adulteration of Beeswax with Paraffine.**—To detect the mixture of paraffine with wax bearing the title of "purified wax," the following process has been recommended by Mr. A. W. MILLER:—Heat 100 grains of the manufactured article with an ounce of concentrated sulphuric acid to 177° for a quarter of an hour or twenty minutes; add a few ounces of water, and leave it to cool. On the surface will be found a

cake of paraffine weighing 80 grains. Should some of the carbonic particles produced from the wax continue suspended in the congealed paraffine, it must be melted again, and stirred round while it is hot, that the intermingled substance may sink to the bottom. Melted paraffine adheres so closely together on cooling, that its surface at last appears concave, while pure wax always forms a horizontal surface. *Bayerisches Industrie- und-Gewerbe-Blatt, Sept.* 1875.

**Tea-production in British India.**—In the year 1851 the export of tea from Calcutta, the only mart for this article, amounted to 262,839 lbs. The last trade returns make the export of tea from Bengal and Assam to be 19,285,000 lbs. Hitherto Indian tea has found its way exclusively to England, where it is generally mixed with tea from China. America, which is the chief customer for Japanese tea, has kept aloof from the Indian market; but a taste for the strong Indian sorts of tea is beginning to gain ground, and it is probable that there will soon be a powerful competition between them and the Chinese tea in the Russian market. *Oesterreichische Monatsschrift für den Orient, Dec. 15th,* 1875.

**Preservation of Articles of Food by Cold.**—Near New York there is a large and flourishing establishment, where valuable fish, such as salmon, is preserved.

The first floor of this establishment entirely consists of a gigantic cooler, with double zinc walls, in three divisions, which are themselves each divided into two compartments. Ice and salt ground together in a mill are put into the spaces left between the walls, through openings in the floor of the second story, these openings being arranged in such a way that any particular compartment can be cooled quite independently of the others.

After the fish have been cleaned, they are put into earthen pans in layers, separated by beds of salt and ice. They are then left in this state till they are completely frozen. Afterwards they are hung in the icy chambers, where the temperature is kept about twenty degrees below freezing point. The fish thus become as hard and stiff as blocks of ice and bars of iron. In this state they are preserved even for a year, and are as fresh at the end of the time as if they had just been caught. They only require thawing to be fit for cooking. The fish are stored in summer, when they are abundant, and usually preserved till winter. *Les Mondes.*

## § 5. *Fuel, Heating, Illumination, &c.*

**Economy of Combustibles.** — Messrs. ERICHSEN and MAARDT have invented the following method of economizing combustibles. It consists in a combination of coke ovens and gas retorts, arranged in such a way that the heat produced in the coke ovens during the making of the coke is partly utilized in producing crude illuminating gas. This gas is conveyed by suitable pipes to the oven, where it meets with the lost heat and the gases produced in the coke ovens. The admission of the gas, the products of the coke ovens, and the air is regulated at discretion, so as to maintain a uniform temperature. This system is employed at Copenhagen in a salt factory to produce the evaporation of mother water. The coke obtained is of good quality, and suffices to cover the cost of the coal. In Denmark and Sweden the limekilns are thus arranged: the kiln is vertical, the coke ovens and gas retorts are grouped round the base, and the gases are thus easily disengaged. The limestone is put in at the top of the kiln, and the products of combustion are taken out at the bottom. In Bohemia it is intended to apply the same principle to metallurgy. It is capable of application to every species of manufacture.

**Knoblauch's Universal Fire Grates.**—This system of fire-grates, invented by M. KNOBLAUCH, of Munich, has latterly come into extensive use. It consists of slender perforated bars of 7 and 5 millimetres (about a quarter and a fifth of an inch) at the upper edge, which rest on cross-bars similarly perforated, in cast-iron frames, and, when completely fitted up, present a smooth surface, which is bent in towards the middle. The peculiarities of the system are the frame-work and cross-bars, and the free circulation of air in the grate. It has been found by experiment that the grates are suitable for all kinds of fuel, and economical in the quantity consumed, while the bars have been in the fire for a year and a half without sustaining any injury. They allow the use of brown coal, coal-dust, sawdust, turf, and other materials hitherto unfit for steam-boilers or any fires requiring a large surface of grating. The free circulation of air secures a complete consumption of the combustibles, and in boilers the hot gases ascending from the grate fill the whole interior but form no pointed flame, and thus the boiler is less injured than by any other system. *Bayerisches Industrie- und-Gewerbe Blatt, Sept.* 1875.

**Photographic Paper for Drawings of Machines, &c.**—The compound by means of which paper may be made sensitive for copying drawings is thus obtained. Dissolve 31·7 grammes (489 grains) of red prussiate of potash in 500 cubic centimetres (29·6 cubic in.) of water, and at the same time precipitate by ammonia the oxide of iron contained in a solution of 2·8 grammes (43·2 grains) of chloride of iron in 50 cubic centimetres (2·96 cubic in.) of water. Dissolve the precipitate in crystallized oxalic acid, and then mix 300 cubic centimetres (17·7 cubic in.) of this solution with 100 cubic centimetres (5·9 cubic in.) of the prussiate solution, taking care to perform the operation out of sunlight. The paper should be simply steeped in this solution and then dried. By exposing it to the light, under a drawing placed beneath a square of glass, the lines of the drawing may be reproduced in white on the paper, which becomes blue. The colour is fixed by washing with water. *Revue Industrielle, Dec. 15th,* 1875.

**Anthracite Coke.**—Anthracite possesses a very high degree of heating power, and contains much less sulphur and ash than ordinary coal. It has the disadvantages that its small pieces cannot well be used, and under the influence of heat it cracks and separates easily. Consequently it is little used in the blast-furnace, where dust forms with the cinders pasty masses, which it is almost impossible to burn or to melt. Messrs. PENROSE and RICHARDS, of Swansea, have adopted the plan of burning it to coke by mixing it with bituminous coal and pitch in the following proportions: anthracite 60 per cent., bituminous coal 35 per cent., and pitch 5 per cent. The material is put into a Carr's disintegrator to pound and mix it. The suitable proportions are introduced by a mill hopper, which is moved by three elevators. The furnaces are of the oblong form usual in South Wales. Each furnace receives through a hole in the roof about four tons of the mixture, which is levelled by means of a poker through the door at the bottom. A layer of about two inches thick is added and levelled. The furnace is lighted by throwing a few shovelfuls of live embers on the surface, and the operation is performed as if one were dealing with bituminous coals. About 80 per cent. of coke is obtained, of a grey colour, hard enough easily to scratch glass, and weighing 23 per cent. more than the coke of bituminous coal. This coke absorbs little water, scarcely 2 per cent of its weight, even when it is plunged in it. In an ordinary fire, or in the blast-furnace, it burns very regularly, without crumbling or crackling.

## § 6. *Miscellaneous.*

**Theory of Hail.**—According to M. COUSTÉ, hail is a meteorological phenomenon peculiar to temperate regions, because on the one hand it requires the concurrence of a powerful water-spout, and on the other the water-spout arises from the action of the solar rays on the upper part of the hail-cloud, and this action is reduced to nothing when the rays are nearly vertical (the hail-cloud being then sheltered by the clouds above), and is also too feeble when the rays are nearly horizontal. For the same reasons hail is produced only in the day-time, and in the hot season.

The fall of the hailstones is slow, because the moving current of the water-spout offers a powerful resistance to it. It takes place in straight parallel lines, inclined in the direction of the moving hail-cloud, because the hailstones necessarily partake of this motion.

Electricity has no other essential influence in the formation of hail than to give the hail-cloud a reddish tinge, a circumstance which is not an invariable accompaniment of the phenomenon. The hail-cloud does not contain any hail completely formed. It is only an ordinary cloud, very thick and charged with water-drops, placed in circumstances adapted for the generation and support of the water-spout, which is the chief instrument of the storm. *Comptes Rendus de l'Académie des Sciences.*

**The Russian Fleet.**—The whole Russian fleet, on all seas, consists of 29 ironclads and 198 other vessels, carrying altogether 527 guns. The tonnage is 173,917, and the horse-power 32,728. *Stummer's Ingenieur, Dec.* 3, 1875.

**Emigration to the United States.**—According to the report of the Washington Statistical Department, based on the returns from the custom-houses in the Confederation, the number of passengers who arrived in the United States within the year ending June 30, 1875, was 295,630. As 50,898 of these were citizens of the States returning from other countries, and 17,134 foreigners not intending to settle in America, the number of emigrants was only 227,498, which is 180,149 less than in

the previous year. This decrease is chiefly attributable to the reduction of wages, which in two years has amounted to nearly 25 per cent.

According to the returns for the quarter ending Sept. 30, 1875, the number of emigrants continues decreasing, while there is an increasing number of persons returning from America to their native countries. *L'Explorateur.*

**Progress of Life Insurance in Germany.**—In 1854 there were fourteen life insurance societies in Germany, which had risen to fifty-one in 1875. The sums insured from 1854 to 1863 amounted to 203,888,972 thalers (£30,583,345) on 218,298 lives. From 1864 to 1875 the sums insured amounted to 697,101,266 thalers (£104,565,190) on 770,237 lives. The amount insured in 1854 was 5,890,211 thalers (£883,531), in 1875 it was 101,052,295 thalers (£15,157,844). *L'Economista, Dec.* 12, 1875.

**Paper from the Cactus.**—Mr. WALKER, of Philadelphia, is about to set up a factory at Los Angelos, in California, for making paper from the cactus plant. *Revue Industrielle, Dec.* 15, 1875.

**Exhibition of the Mulhouse Industrial Society.**—The Mulhouse Industrial Society will celebrate the fiftieth anniversary of its establishment next May. The celebration will not be confined to members of the society, but all the population of the Upper Rhine will have an opportunity of taking part in it. That it may furnish the means of showing to the general public the progress accomplished by the industry of the district in the course of the last half century, the Industrial Society has decided to organize an exhibition of manufactures produced there. Works of art will also be admitted from exhibitors who are not members of the Industrial Society. *Revue Industrielle, Dec.* 15, 1875.

**Porcelain.**—In 1873 there were in France 387 manufactories of ceramic productions: 76 produced porcelain, 20 opaque porcelain, and 229 earthenware. They employed 17,746 workpeople, and used 1,790 horse powers, 913 of which were steam, and 877 hydraulic. The total production reached the value of 44,795,860 francs (£1,791,834). The chief materials are porcelain clay for porcelain; for opaque porcelain, pipe-clay, white sand, salts, and colouring matter; for earthenware, clay and a certain number of salts, chiefly with lead for their base. *Revue Industrielle, Dec.* 15, 1875.

**The Application of Peruvian Guano to Tanning.**—The process of tanning comprises not only the preservation of the skin, but also the operations by which very fine and elastic goods are obtained. In addition to a careful selection of the raw material, great attention must be bestowed in the early stages of the work upon the bare places in the hide. For this purpose, as well as for tanning white and finer sorts of leather, dog manure is used as a mordant, which takes away the stiffness and lumpiness arising from preceding processes, and makes the skins more susceptible for the subsequent operations of tanning in the alum-broth, since the action of the dog-manure consists chiefly in removing the lime and grease.

As the manure of fowls and pigeons operates in the same way as dog-manure, it was natural to try the effect of Peruvian guano, which is analogous in chemical composition and identical in origin. This has been done by Messrs. Bencker and Son, at Joachimsthal, for the last two years, and guano has been found the most suitable substitute for dog-manure, both on account of its effective operation, and its being more easily and conveniently procured. *Bayerisches Industrie-und-Gewerbe-Blatt, Oct.* 1875.

**Utilization of Greasy Cotton Rags.**—The foundation of a new branch of industry has been laid by an enterprising Englishman, who turns to good account the cotton rags that have been used for cleaning engines, and hitherto burnt as useless. He buys up all he can get from large establishments and the Royal Arsenals, and washes them in a chemical solution which cleanses the cotton from grease and other impurity. When dried, they are as good as new. The grease is purified, and the residue sold to the soap-manufacturer.

**The Stone Age.**—Dr. Hans, the Swedish antiquary, has lately made an interesting discovery in the neighbourhood of Christianstadt. He examined a tumulus of the bronze age at Nymo, near that town, in which, under a great heap of stones, were found two burnt bodies and a small bronze ring. There were also found, in a kind of stone chest, the bones of about twenty persons, all buried in a sitting posture, with amber necklaces. But the most important discoveries were made in a cave at Fjeldkinge. By the side of the entrance were many hundreds of earthenware pots, richly ornamented, and two flints. Inside were found two human skeletons, a quantity of amber, an animal's tooth, perforated, four bone vases, some flints, &c. On the south side were the bones of four skulls, and a single skull in a perfect state of preservation. *Les Mondes, Nov.* 25, 1875.

**Guano.**—According to M. Habel, it is a mistake to suppose that the accumulation of guano on the islands of Chincha consists of the excrements of sea-birds inhabiting these islands. In reality, it is composed of two strata, differing both in the mode and date of their origin. The upper stratum, far the smaller, is composed of the excrements and bodies of birds and seals now occupying these islands. The lower stratum took its commencement in pre-historic times from the excrements of birds, let fall to the bottom of the sea, only a limited portion of which was occupied by these birds. The stratum thus formed has been since raised (as still occurs in the present day), at the same time as the bottom of the sea, and the islands themselves are only the result of these upheavals.—*Paper read before the Imperial Academy of Vienna.*

**Remains of the Bronze Age.**—At Gmunden, in Upper Austria, were lately found eight feet below the soil, in an undisturbed alluvial deposit, some bones of animals, among which were the cubitus of a dog belonging to a race like the water-spaniel, some fragments of black earthenware not varnished, and two bronze needles of very beautiful workmanship, one of which was unfortunately broken. The ornaments consisted of various systems of lines, engraved with the burin or cut with the chisel. The unbroken needle is 8½ inches long, and coated with a layer of green carbonate of copper, on which was deposited a thin layer of rusty-brown enamel, no doubt caused by contact with ferruginous waters containing carbonate of lime in solution.—*Report of Dr. Koch to the Imperial Institute of Geology, Vienna.*

**Lake Dwellings.**—One of these dwellings is found near an island on the west of the lake of Stamberg, south of Munich. In it are stone and bronze implements, and remains of the buffalo and the bison, as well as domestic animals of a comparatively recent period. The remains of fish and birds are comparatively rare—those of animals are not uncommon. Human bones are not infrequent; they testify to a short-headed race of high stature. The whole fauna presents a remarkable analogy with that of the Swiss lake-dwellings. The horses and oxen show a striking resemblance to the diminutive races of these animals peculiar to the turfy neighbourhood of Munich. *Report of Dr. E. Naumann to the Austrian Imperial Institute of Geology.*

**Simultaneous Meteorological Observations in the Northern Hemisphere.**—At the International Congress of meteorologists, which assembled at Vienna in September, 1873, the delegate from the United States, General Albert Myer, proposed, in the name of his Government, that the chief meteorological phenomena should be observed at the same physical instant in all the land observatories. This proposal was accepted, as it deserved to be, and its execution was commenced January 1, 1874. The meteorological systems, or districts, which have hitherto taken part in the enterprise, have the following central stations:—

| | | | |
|---|---|---|---|
| Washington, which observes at | | . | 7h. 35m. A.M. |
| Greenwich | " | " . | oh. 45m. P.M. |
| Paris | " | " . | oh. 53m. " |
| Brussels | " | " . | 1h. 1m. " |
| Utrecht | " | " . | 1h. 4m. " |
| Christiania | " | " . | 1h. 26m. " |
| Copenhagen | " | " . | 1h. 33m. " |
| Berlin | " | " . | 1h. 37m. " |
| Vienna | " | " . | 1h. 49m. " |
| Constantinople | " | " . | 2h. 39m. " |
| St. Petersburgh | " | " . | 2h. 44m. " |

These various districts comprise many meteorological stations, the United States including Canada and possessing more than a hundred. It is expected that this co-operation will be attended with very beneficial results to commerce and agriculture. The observations made simultaneously should be collected and sent to foreign stations, from which the results there obtained should be sent in return. Already America engages to furnish a copy of its documents to all those who co-operate in this international enterprise. *Les Mondes, Nov.* 25, 1875.

**Infrangible Glass.**—Herr STUHL, of Berlin, has succeeded in making glass cylinders which resist changes of temperature, and do not crack on being dipped into cold water. *Stummer's Ingenieur, Dec.* 17, 1875.

**Artificial Ivory.**—According to Kaufmann, an artificial ivory which admits of being cut and pressed into various forms may be obtained from phosphate of lime and gutta percha.

**Rapid Manufacture of Paper-pulp from Straw.**—The following is Mr. DIETERICH'S method of making paper-pulp from straw. Put 1,100 lbs. of cut straw in a boiler. Prepare a fluid compound of 165 lbs. of caustic soda, 16½ lbs. of yellow soap, 33 lbs. of ammoniac, with a density of ·97, and 220 to 330 gallons of water. Put this liquid into the boiler, and add water till it is four-fifths full. Give the boiler (hermetically closed) a rotatory motion, and by opening the mouth produce ebullition, which must continue for four hours, care being taken that the pressure of the steam before opening the mouth is not less than three atmospheres. At the end of that time close the mouth, and make the boiler rotate continually for an hour under the same pressure, so as to condense the steam.

If there are no stone basins or troughs for washing with two cylinders, in which the washing of the boiled straw may be thoroughly accomplished, it may be done in the boiler with water heated by the waste steam to hasten the process. This washing of the straw requires very great care, and is better done than in basins or troughs, which are attended with less waste and loss. It should be continued with a slow and regular movement, until the water has lost all colour.

The washed straw is then to be put into the apparatus, where it is reduced to the condition of pulp. It must then go to the refining apparatus, consisting of two large mill-stones, which destroy the knots and other lumpy substances which still remain, and at last to the bleaching apparatus. This operation is performed in basins or troughs: 1,100 lbs. of straw require 110 to 120 lbs. of chloride of lime, a clear solution of which, prepared at least twelve hours before with hot water, must be mixed as thoroughly as possible with the pulp. The operation ought to be completed in three hours, and then 22 lbs. of sulphuric acid should be added, on which the chloride is decomposed, and the pulp becomes perfectly white. Lastly, put the pulp in pressed filters, which reduce it to the form of cakes suitable for manufacturing purposes. *La Gaceta Industrial, Dec.* 10, 1875.

**The Industrial Development of Japan.**—From a report of the English Consul at Hiogo and Osaka it appears that remarkable progress has been made in Japan within the last few years. Since the railway and electric telegraph has connected Osaka with Kobe and Kioto, and the mint has been established according to the European system and the gas-works have been under Government control, this place has made rapid advances in manufacture and trade. With confidence and success small factories have been erected which vie with foreign competitors in almost every branch of industry. A paper manufactory produces a ton of paper per day; a sugar-refinery, four or five tons; a cotton factory, with steam power, yarns and calicoes. There is also a carpet manufactory in which woollen and cotton carpets, as well as cocoa-nut matting, at reasonable prices are made. The making of hats, caps, and shoes, after the European fashion, is carried on with success, and Japanese enterprise has already mastered the making of mechanical roads. The sewing machines for the above articles of clothing were at first imported from America, England, and Germany, but many are now made in Japan, and, though inferior in quality, yet they are extensively sold on account of their cheapness. Revolvers and side-arms, after the European fashion, are made in large quantities at Osaka. A brick machine is contemplated, which is to produce 20,000 bricks a day; while a glass factory, already in operation, produces a number of the most varied articles after the European models. As all this progress has been made within a very few years, and without any protective duties, it is doubtful whether Japan will long continue to be a profitable market for European and American goods.

**The Ivory Trade.**—The quantity of ivory imported into England every year amounts to 650 tons, of which 350 tons are employed for the use of the country. The knife manufacturers of Sheffield alone take 250 tons a year. The weight of the tusks varies from 1 lb. to 150 lbs.; the value is £30 to £35 per cwt., according to quality.

To obtain this quantity of ivory, 50,000 elephants are sacrificed every year. Bombay and Zanzibar export 160 tons of ivory annually; Alexandria and Malta, 180 tons; the West Coast of Africa, 20 tons; the Cape, 50 tons; and Mozambique, 14 tons. Ivory comes to Bombay from all the southern regions of Asia and the West Coast of Africa. The largest tusks come from the African elephants, and are exported at Zanzibar, the ivory being of good quality, opaque, soft, easy to work, and not cracking readily.

The ivory which comes from Ambriz, Gabon, and the countries south of the equator, is called "grey silver." It preserves its whiteness although exposed to the air,—a quality not common to all kinds of ivory,—and it does not become yellow with age, as the ivory from Asia, the East, and Africa. This quality is most highly valued in the European markets. The ivory of Siam is much sought after for engraving and ornamental work, on account of its great elasticity and transparency. The tusks that come from Mozambique and the Cape never weigh more than 70 lbs.

In the Asiatic regions of Siberia fossil ivory is found from elephants preserved under the ice from most distant times. *Moniteur Industriel Belge, Dec.* 10, 1875.

**Pocket Telegraph.**—AAGESEN and OLSEN, 16, St. Kobmagergade, Copenhagen, manufacture a portable Morse-instrument small enough to be carried in the waistcoat-pocket. The price of one of these little instruments is 1 Danish krone. *Industrie Tidende (Copenhagen), 29 Aug.* 1875.

**New Spectro-Electric Tube.**—In the under-mentioned number of the "Comptes Rendus Hebdomadaires" of the French Academy, MM. DELACHANEL and MERMET give a figure and description of a new electric tube for spectroscopic use, invented and patented by them. It consists of a glass tube, through the bottom of which passes a platinum electrode, covered by a capillary tube, forming a sort of cap; the opposite extremity of the glass has a cork plug, through which passes another capillary tube traversed by a platinum wire terminating in another electrode. The solution to be analyzed is poured into the glass so as not to rise more than half way up the lower electrode. A persistent drop then forms at the end of the latter, by capillary attraction. This becomes illumined when an electric current is passed through the wires, and permits the spectra to be observed uninterruptedly for unusually long periods. The advantages claimed for the tube are:—Fixity of the electric spark allowing of prolonged observation; suppression of meniscus and the resulting absorption of light; the electrodes being inclosed in a tube are protected from corrosive action; possibility of examining the substances integrally; possibility of forming a collection of spectroscopic tubes containing solutions of different bodies, for purposes of demonstration. The inventors state that the assistance they have derived from this little instrument justifies them in strongly commending it to the notice of those engaged in spectroscopic analysis. *Comptes Rendus, lxxxi. 26th Oct.* 1875.

**Mud Spots on Varnish.**—High-class finishing varnishes, whether of English or American make, possess their wearing qualities from the simple fact that they retain their elasticity or oily principle to a great length of time. The surface becomes hardened sufficiently to resist dust and to admit of being washed, but the *body* of the varnish remains soft and sensitive, and mud allowed to dry on the surface of this varnish both stains it and extracts by capillary attraction the oil contained in the varnish. Each spot of mud, according to its size and shape, acts on the varnish immediately beneath it, but no further, from the fact that a suction is created by the evaporation of the water contained in the mud. Different kinds of soil act with more or less injurious effects. Sandy soil would have but a slight effect upon a varnish which would be badly stained by a more adhesive clayey soil, and the filth of a large city is still more fatal to the gloss. *American Carriage Monthly.*

**Cotton Industry in the United States.**—It appears from a return just published at Washington, under the sanction of the statistical department, that in 1870 there were in the United States 241 cotton factories, working altogether 96,400 spindles, which gives an average of 400 spindles for each factory. According to a report presented by the Committee of Commerce and Agriculture, the capital invested in this industry amounted to 40 million dollars, and the number of hands employed was 100,000. The consumption of cotton was 27 million pounds, producing 81 million yards of calico, valued at 24 million dollars.

GELDING COPPER.—The two pieces to be welded are brought to a melting heat, and after being sprinkled with borax are joined by hammering. They are then reheated to a white heat, rapidly sprinkled with chloride of magnesium or common salt, and the welding is effected easily by hammering. During the hammering a current of chlorine (?) may be directed on the bar to impede any action arising from the oxygen contained in the atmosphere.

## IMPROVED SEWING MACHINE MOTOR.

DOMESTIC motors, unless they present the three elements of safety, simplicity, and cheapness, stand little chance of gaining popular favour. We are inclined to believe the same is true of apparatus which, apparently filling the above conditions, is nevertheless of a nature intrinsically against which prejudice exists. Thus, we doubt if any woman would charge herself with the care of a boiler and steam engine, however small its dimensions, or would undertake to manage the battery of an electro-magnetic machine; the one she has connected in her mind with explosions and similar casualties, while of the other the average female is, as a rule, totally ignorant, and hence timorous. Every woman, however, has some idea of clockwork—knows that it runs when wound up, and is not liable to sudden freaks in the way of bursting and giving disagreeable shocks; and consequently, if she finds she can drive her machine for some time by turning an exaggerated clock key a few revolutions, the chances are that she will do so rather than tire herself over the treadle, simply because, in the case of clockwork she is familiar with the power she deals with, while in the case of steam or electricity she is not.

Fig. 3.

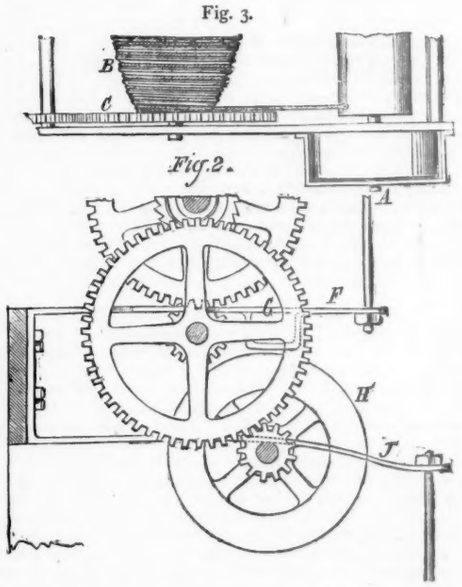



Fig. 2.

The inventor of the device illustrated in the annexed engravings has produced an arrangement of spring mechanism for actuating sewing machines, which, judging from a recent inspection of its operation, is capable of giving excellent results. Everyone, it is presumed, is reasonably familiar with the general principles of such apparatus, and hence an allusion to them is not needed, nor is it deemed necessary here to enter minutely into the inter-engagement of the various transmitting wheels. Suffice it to state that the connection between the parts is simple, and readily understood from a glance at the device itself. The points to which attention is especially directed are the mode of insuring an equal and uniform power during the entire period that the spring is unwinding, and the brake mechanism by which the motion is controlled.

To insure the best application of power throughout, the inventor has recourse to an arrangement very similar to the ordinary fuzee. On the spring shaft, A, fig. 3, is a cylinder, to the periphery of which a chain is attached. The latter is also secured to the larger portion of the spirally grooved drum, B, so that the motion thereby transmitted to said drum rotates the large cog wheel, C, and thence passes to the other mechanism, and, finally, to the belt pulley of the machine. The winding is done by a winch applied to the shaft, D, fig. 1, with the pinion on which and also with the main wheel, C, and idle wheel, E, may be slipped into and out of gear (by a longitudinal motion of its shaft in its bearings) at will. By this means not only is the powerful coiled spring, represented at the right of fig. 1, wound, but the chain tightly wrapped in the grooves of the drum, B, fig. 3. It will be noticed that, during the first turns of the winding, which require but little power, the chain winds about the larger portion of the drum, B, between which and the diameter of the driving wheel, C, there is less difference of leverage; but toward the end, when much more power is needed to finish the work, a greater leverage is afforded through the decrease in diameter of the portion of the drum on which the chain then winds. When the spring begins to unwind, and so to drive the mechanism, the exact converse of the above takes place. The power, at first strong, is applied to the smaller portion of the driving drum, and then, as it diminishes, its point of application gradually changes so as to work with proportionally increased leverage. The drum being properly shaped, the result is to cause strong power to act upon short levers, and light power on long levers, effecting a uniform transmission of force. The same end may be reached by replacing the cylinder with another conical drum.

The brake mechanism is represented in fig. 2. F is a flat elastic bar, to which is attached a cushion, G, which acts as a brake shoe against the fly wheel, H. To the outer end of the bar, F, is secured a rod which passes up through the table, and ends above in a button, I. By raising the latter, the cushion is removed from the fly wheel and the works allowed to operate; by lowering the button, the brake is again applied, and stoppage results. A brake at J presses upon the belt wheel shaft, and is held down upon the latter by the pressure of the foot upon the bar, K, under the table. By increasing the pressure, and consequently the friction of brake, J, the machine is caused to travel more slowly; and, by relaxing the same altogether, full speed is permitted.

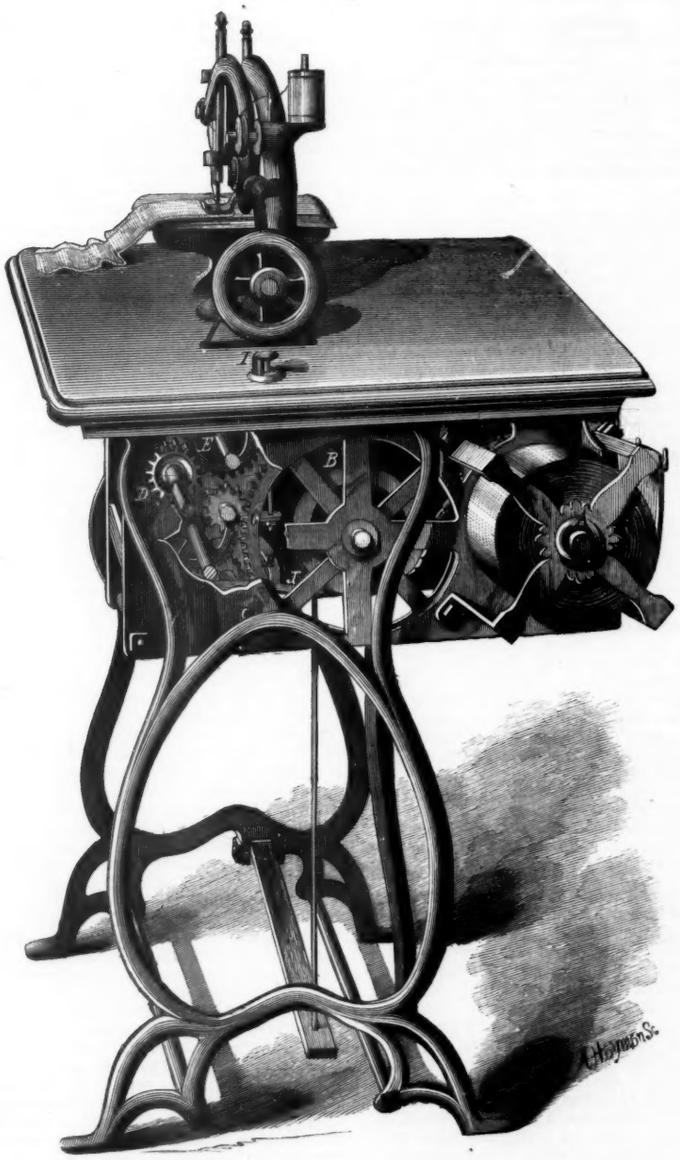
Sufficient being now said to convey an idea of the construction of the device, we may state that its general appearance is excellently shown in fig. 1. It may be applied to any machine, requiring no other modification of the latter than the replacing of the table, if of ordinary size, by a larger one. Eight turns of the crank—which, owing to the interposition of the idle wheel, are made in direction from the operator—suffice to wind the spring and set the machine in operation at full speed, estimated at about 720 stitches per minute for twenty minutes. This, though very much faster than is ever necessitated in actual practice, was accomplished several times in our presence, the needle in one instance piercing many thicknesses of muslin or linen. Probably once in every half hour would be all the winding required for continuous work, and this, as we have above explained, is an operation of little difficulty, done in a very few seconds, and controlled by the ratchet wheel and pawl shown in fig. 2.

The invention appears to us to be a successful application of simple and, certainly, not expensive mechanism, to a much-needed end. Women's work upon the treadle is none of the lightest, and, while always temporarily fatiguing, sometimes results in permanent physical suffering. This, added to the fact that the sewing machine is one of the most important, if not the first, of modern household gods, should bespeak careful examination for the device. *Scientific American*

## MERRYWEATHER'S "SOLID DIE HOSE RIVET."

A NEW class of hose rivet, made of the usual material, copper, has been brought out by Messrs. Merryweather and Sons, fire-engine makers, London. These rivets appear, upon close examination, to be far superior to those made in "split dies;" the latter have frequently a "fin" on the side of the rivet, as also under the head; this "fin" must naturally weaken the hose, and cut the leather of which it is made during the riveting process. Messrs. Merryweather found it necessary to introduce a superior class of rivet, owing to the high pressure that their hose has to bear when applied to their steam fire-engines, frequently not less than 150 lbs. on the square inch. These rivets are manufactured by Messrs. Merryweather at their Lambeth factory, at a considerably lower price than the split-die rivets, at the rate of one million per working day, and, in addition to the solid die rivet being without a "fin," they are made with a true head, which is far from the case with those of the split dies. These rivets are equally preferable for riveting bands for driving machinery.

Fig. 1.




YOUNG'S SEWING MACHINE MOTOR.

# *Engineering, Building, &c.*

ABSTRACTS FROM FOREIGN PERIODICALS, TRANSACTIONS OF SOCIETIES, ETC.

## § 1. *Engineering.*

**THE Tunnel under the Channel.**—The soundings for the submarine tunnel between England and France are actively going on a few miles from the English coast. Every evening the vessel conveying the persons engaged in them returns to Dover, Calais, or Boulogne, and the work recommences the next morning. The engineers intrusted with this important work are quite satisfied with the results attained, and hitherto nothing has occurred to contradict their previous opinion as to the nature of the bed of the channel.

**Self-Acting Grapnels.**—M. TOZELLI has invented self-acting grapnels, which he brings into operation by giving directions from the interior of the diving-bell invented by him. As soon as he has reached the bottom of the water he gives orders, by means of the telegraph, to the captain of the vessel accompanying him, for a boat to go out with a self-acting grapnel, which is let down and moved along at a certain distance from the bell, to the right or the left, backwards or forwards, till it has reached the object it is to seize. Then it is lowered, and on falling it grasps the object.

When the depth is great and the light feeble, an electric lamp is lowered with the cord of the grapnel, so that every object is clearly seen. M. Tozelli says that at a depth of about a hundred yards objects may be clearly distinguished if the bottom is covered with grey sand and the surface of the sea is calm. But if the bottom is covered with dark plants it is necessary to light the lamp at a depth of only five-and-forty yards, especially if the sea is rough. It is even necessary to whiten the grapnel to make it clearly visible.

M. Tozelli has often observed that in summer time, when the lamp is lit under the water, a great number of fish of all sizes come round the lamp, and, by simply discharging a torpedo, hundreds of pounds' weight of them might be killed in a moment.

M. Tozelli has already fished up many things with his self-acting grapnels. His double self-acting grapnel is an instrument which will completely alter the oyster-pearl fishery, for it can go to any depth. As it goes down, it opens its claws through the natural pressure of the water, and as soon as it has touched the bottom, and when it is drawn up, it closes its arms to retain the object it has caught hold of.

Among the curious objects which M. Tozelli has lately fished up in the roadstead of Marseilles, were a number of stray portions of the boiler of the steamboat *Phocéen*, which sank off Cape Couronne in 1843. It is curious to see how well they have kept for thirty-two years in salt water. *Les Mondes.*

**Hydrothermical Machine.** — The Marquis TOMASI has succeeded in constructing a hydrothermical prime mover which is attended with a practical result. The expansion and cooling of oil are so regularly established that, with the aid of gear, a hundred piston-strokes a minute are obtained directly or indirectly. These hundred strokes suffice to produce an amount of work which with his small model is only one-third of a horse-power, but, with other models, it may amount to many horse-powers. The Marquis Tomasi has conceived the happy idea of chiefly making it a secondary mover, intended to utilize the heat which the steam-engine allows to be lost without advantage. In fact, he has succeeded in working his hydrothermical motor with the steam which is allowed to escape into the air after its expansion, by connecting the steam-engine with a hydrothermical engine, which thus, without expenditure, contributes a considerable part of the power of the steam-engine.

Formerly great advantages were expected from the use of ether, chloroform, and ammoniac for utilizing the waste steam of engines; but such serious inconvenience and danger resulted from the employment of these active and noxious vapours, that they were abandoned. There is reason to hope this will not be the case with the expansion of oil, but every steam-engine will have its natural complement, so as at last to attain the economical employment of heat in mechanical industry, locomotion on railways, and steam navigation. If by this means the consumption of combustibles were reduced by a third or even a fourth, a very happy revolution would be accomplished.

The auxiliary hydrothermical motor possesses, moreover, a very valuable quality from which industry may derive great advantage. The force of expansion of oil is so great, that one can hardly form an idea of it, consequently the hydrothermical motor will be capable at any moment of a strong pull or an irresistible thrust. Coupled with steam-engines on tramways and locomotives, it will start them without difficulty, and assist them powerfully in ascending inclines. With an instantaneous agent of great power at hand, the moving power, which is now badly turned to account, may be greatly diminished, since, when once the train is at full speed, a much less power would suffice to keep it up. *Les Mondes.*

**On the Construction of Lightning Conductors.**—Whether the point of a lightning conductor be of platinum or copper, whether it be tapering upwards, as Franklin directed, or forms an angle of 30 degrees, according to modern instructions; whatever care also be taken in the combination of the metals, the construction is certainly defective in point of conductibility. Moreover, there is reason to fear this diminishes as time goes on. This seems to be proved by the fact, that a lightning conductor is most frequently struck at the joint, and there the burning is caused.

Originally Franklin desired the rods to be of a single metal. In consequence of the rapid oxidation of iron, successive Commissions have been obliged to modify the extremity of the rod. We think it is possible to return to the first idea, now we know how to cover iron with a metal, viz., nickel, which will form a perfect varnish on its surface, protecting it against oxidation, and possessing the necessary conductibility.

We have made experiments on the conductibility of nickel deposited on an iron rod. The nickelized surface proved a little more conductive than the iron substance. It offers greater resistance to the electric sparks from a strong battery. This same bar, after being left in water for ten days, gave no sign of change. The electric conductibility remained unaltered.

We think, therefore, it would be better to abandon copper or platinum for the points. The rod, of one single piece, should be made of nickelized iron as well as the point. The lightning-conductor would thus be preserved from burning, and would always have the same preventive effect. Moreover, the conductibility would remain constant, without the disadvantages which now follow from want of superintendence. This last point is very important. *Paper by M.E. Saint-Edme, communicated to the Academy of Sciences, Paris.*

**New Steam Carriage.**—M. BOLLÉE, a mechanical engineer of Mans, has constructed a family steam-carriage, by means of which he can take his drives, convey his wares to the station, and travel considerable distances. Not long ago he went by it to Paris in eighteen hours, and, after having taken a few turns there of ten or fifteen miles, returned to Mans through Vendôme. The carriage, with its supply of water and coal, weighs not far short of 4 tons. The two driving wheels are about 4 feet in diameter, and about 4½ inches broad. The two front wheels are rather more than a yard in diameter. Each wheel is placed between two pair of springs, as near the middle as possible, to diminish the pressure of the burden on the axle, which is thus reduced to the smallest dimensions. The two driving wheels move freely on the hind axle; the two front wheels are still more independent of each other, and the guiding apparatus is so arranged that, when it is necessary to make a very short turn, they each take a direction perpendicular to the line joining their point of contact with the ground to the centre about which the driver may wish to turn the vehicle. This independence of the four wheels, and especially this peculiarity of the front wheels, secures to the vehicle a safety and facility of turning not yet attained.

Behind is placed the vertical boiler on the Field system, which is quickly heated, with an external diameter of about 2¼ ft., and 3¼ ft. high, containing 194 water-circulating tubes rather more than an inch in diameter. It supplies four cylinders, grouped, two and two between the wheels at an angle of 45 degrees, each of the two groups controlling a special shaft, which acts by means of a wheel-gear and endless chain on the corresponding driving wheel.

All the parts of the carriage, the engine, and the boiler, are made of steel, with a lightness carefully calculated to meet the demands of resistance. In front are all the necessary means of guidance within easy reach of the driver, who is seated in the centre of the width, facing the direction to be followed, and ready to perform all the evolutions that circumstances may demand.

After having cleared the cylinders by means of taps managed by hand, and having opened the general communication of the slide-valves with the boiler, he regulates by pedals the quantity

of steam which is let into each group of cylinders, thus accelerating or retarding their movements as required, till the stoppage of the driving-wheel. He can even back the carriage by acting on a Stephenson slide, which allows him also to modify the supply of steam, whether when going forwards or backwards. The guiding apparatus which acts on the front wheels is constantly under the control of the right hand, which never leaves it, and the left hand can also, behind the seat, change the speed of travelling as may be necessary, independently of the speed of the engine itself, which at a running pace makes 180 double strokes of the piston a minute. The steam-gauge, showing the pressure of the steam, is also placed under the eye of the driver. He has only to sound the steam-whistle to give all needful warning to the drivers of carriages that he passes or meets.

A stoker behind attends to the boiler and looks after the fire. He fills the boiler with a Giffard or a pump from the tender while going along, or from the streams during the stoppages, which are required about every six miles for supplying the boiler. There is a special pump of considerable calibre for this purpose. The vehicle easily goes 12 miles an hour on level ground, and from 7 to 9 on frequented roads. It maintains a speed of 5 or 6 miles an hour up an incline of 1 in 20, and it can easily draw up a vehicle of the same weight as its own. It certainly does not run so easily as a cab, but more easily than an omnibus, on account of there being no pole or team of horses. It stops, sets off again, and gets out of the way with surprising precision, owing to the novel method of guiding the two independent wheels in front. In going through the streets of Paris it is said to have startled few horses, and made so little disturbance as not to attract the attention of people reading in carriages that it met or passed. It may be considered a practical solution of the locomotion problem, and be found very serviceable for tramway conveyance. *Paper by M. Tresca, communicated to the French Academy of Sciences.*

**Mineral Oil best for Lubricating Engines.**—According to *La Revue de l'Industrie des mines en Prusse*, Dr. SCHONDORF found in the cavities of a large Woolf engine a brown mass, composed of 60 per cent. of oxide of iron and about 27 per cent. of sebacic acid. Hence he concludes that the grease employed for lubrication changed, under the action of the hot steam, to glycerine and sebacic acid, and that the latter attacked the metal, otherwise such large quantities of iron could not have been found in those places. It would appear, therefore, that it is advisable to make use of mineral oils, instead of animal and vegetable oils, for greasing cylinders.

**Fortin Hermann's Footed Road-Engines.**—In this engine motion is effected, not by driving wheels, but by veritable jointed feet, which are planted on the ground in succession. Two of these feet are on the frame in front, two others on the hinder part of the engine. They are pressed on to the ground by the action of the steam, and a horizontal engine decides in a suitable manner the oscillations of the connecting rods, which follow these feet and draw the engine in the longitudinal direction. Experiments have proved that by only loading the feet, which are furnished with india-rubber soles, at the rate of a kilogramme (2·2 lbs.) per centimetre (·39 in.) square, an adhesion may be obtained equal to three-fourths of the weight of the driving engine. This adhesion is usually limited to one-fifth of this weight, so that the use of feet renders it possible to draw both on ordinary roads and railways a train four times as heavy as the present plan permits.

The traction of the train continues the same for the same inclination of road, but the increase of adhesion allows of either diminishing a great proportion of the dead weight of the locomotive, or, with equal dead weight, traversing a more uneven road. Consequently M. Fortin Hermann's system greatly increases the applicability of road-engines, and even allows of their travelling on unfinished roads. On ordinary roads it allows of conveying useful loads on inclines of one in ten, which are absolutely unapproachable with the present road-engines. *Technologiste.*

**Use of Copper for the Lining of Boilers.**—M. F. PUPKA, engineer of Vienna, gives the following details on experiments made by M. Feldbacher, engineer to the Austrian state railway, on the lining of locomotive boilers with a sheet of copper, to prevent the accumulation of incrustations. Of the three iron plates which compose the bottom of a locomotive boiler, the two end ones were covered with a sheet of copper of the thickness of a millimetre (·039 in.), the middle one being left uncovered. The engine was in use for two years on a part of the line where the water is of very bad quality. On the removal of the tubes a layer of incrustation was found of about the hundredth part of a metre (·39 in.) thick on the iron surface, and only two to four millimetres (·078 to ·156 in.) on the copper. The iron was in many places corroded to the thickness of a millimetre and a half (= ·05 in.), while the surface of the copper was perfectly smooth, and the iron plate under the copper appeared quite new. The texture of the incrustation was in larger grains on the iron than on the copper. The cost of the lining was from £1 to £3 per boiler.

According to M. Pupka, the advantages of this system are the following:—

1. The duration of the boilers is doubled or tripled, and there is great security against chances of explosion.
2. There is much less incrustation on the smooth surface of copper than on that of iron or steel, which is porous and lightly oxidized, and consequently evaporation is better performed, and the combustibles are turned to better account.
3. Thinner iron plates may be safely used in the construction of the boiler, in consequence of the preservative effect of the copper against corrosion, and hence the weight of the boiler may be diminished.
4. Repairs are considerably lessened. *Technologiste.*

**Welding Plates of Steel.**—Mr. POPPING, of New York, has suggested the following method of welding plates of steel together. Between the plates that are to be welded or soldered is spread a mixture of 500 grammes (1·1 lb.) of pulverized borax, with 50 grammes (·11 lb.) of iron filings, and 125 grammes (·27 lbs.) of cyanide of iron or Prussian blue, moistened with a little water. The plates, kept in close contact by an iron wire, are heated in an oven to a temperature of about 350° to 370°, not to a white heat, and then passed under the rollers. *Technologiste.*

**Carbonic Acid as a Moving Power.**—Dr. H. BEIMS, of Grönnignen, has lately discovered a method by which it is possible easily to obtain carbonic acid under any pressure. It is well known that the production of liquid carbonic acid has been hitherto attended with great difficulty, since the only means known was a very powerful pressure; but Dr. Beims has found out a better and more perfect way of accomplishing the object, viz., by chemical action. He found that, if bicarbonate of soda or potash be heated in an inclosed space to a given temperature, a part of the carbonic acid in chemical combination is disengaged, and in a receiver, where the gas at the normal temperature has an opportunity of cooling, it condenses to liquid carbonic acid. Thus, if bicarbonate of soda be heated to 300° or 400° Centigrade (572° or 752° Fahr.) in a perfectly close wrought iron vessel, liquid carbonic acid of 50 to 60 atmospheres' pressure may be obtained at the ordinary temperature of the air. If, then, the gases of the liquid carbonic acid are withdrawn under a lower pressure than that of condensation, they can evidently be employed as a moving power. Dr. Beims calculates that liquid carbonic acid, which he calls carboleum (*i.e.* carbon oil), may in this way be obtained, which in the receiver has a tension of 50 atmospheres. Sixteen litres (about 28 pints) of this carboleum would be sufficient to do the work of one horse-power for an hour. Taking into account the expenditure of heat necessary to re-evaporate the carboleum in small quantities at a time, proportioned to the wants of the engine, Dr. Beims reckons that for such an amount of work an hour 3 hectogrammes (7½ lbs.) of coal would be sufficient. The same carbonic acid can be repeatedly used, since, after its tension has been exhausted in working the engine, it can be again absorbed by the residuum of the bicarbonate of soda. Consequently it will only be necessary to have in the receiver so much carboleum beforehand as is required to keep the engine going during the re-absorption of the used-up gas. In this way a continually self-renewing force is kept up.

It is obvious that great difficulties will have to be surmounted before this theory can be reduced to practice. Attempts have been for some time made at an engineering establishment in Vienna to construct an engine suitable for such a self-renewing moving power, without any successful result at present. An apparatus is also required for the continual production of carboleum.

But, even apart from the chief object in view, Dr. Beims's discovery has great value, since by means of it the possibility is afforded of producing very high tensions, such as are often necessary in chemical investigations, and on the other hand it furnishes a much simpler method than was previously known of producing large quantities of carbonic acid, which may be of great use in the manufacture of soda-water and aërated drinks of all sorts. *Stummer's Ingenieur, Dec.* 3, 1875.

**Burstyn's Method of keeping Boilers dry.**—Boilers which are not in constant use are liable to injury from rust when lying idle. Before being left unoccupied they should be thoroughly cleaned, dried with fire, and closed as nearly air-tight as possible. To keep them perfectly dry M. BURSTYN recommends the insertion of chloride of calcium free from water,

which, as a secondary product of chemical industry, can be cheaply obtained. A series of experiments in the naval arsenal at Pola have proved that it completely answers the purpose of keeping boilers perfectly free from moisture.

Two steam-vessel boilers were cleaned and dried till the sides showed no sign of dampness. Their cubical contents were 65 cubic metres (about 74 cubic yards), and the contained air weighed 84 kilogrammes (about 185 lbs.). In the starboard boiler 80 kilogrammes (about 176 lbs.) of chloride of calcium of the size of a walnut to a doubled fist were put in on an iron frame. Both boilers were then carefully closed.

In the course of a month they were opened and examined. The starboard boiler, which contained the chloride of calcium, proved to be perfectly dry. The rust which, sticking to the surface, seemed at first to indicate moisture, fell in fine flakes and scales, or as dust, on the slightest shaking, and left the metal quite bare and smooth. The hygroscopic substance showed by its increase that a kilogramme (2·2 lbs.) of water was absorbed and retained in combination. The larboard boiler was apparently dry, but the scales of rust remained fixed, and closer inspection showed that the metallic surface of the boiler was damp. A taper, on being introduced, burnt with a weak, unsteady flame, a portion of the oxygen of the air having been lost in the oxidization, while the flame in the starboard boiler burnt bright and steady, showing there had been no abstraction of oxygen.

The boilers were again closed, and left for another month in the same circumstances, with the same results. For five months the one was completely preserved from injury by rust, while in the other, during the same time, the atmospheric air and moisture caused a wearing away to the extent of half a millimetre (about a fiftieth part of an inch), which for steam-vessel boilers in and out of use is a serious average. It is found by experiment that 80 kilogrammes (about 176 lbs.) of chloride of calcium, which can combine with 48 kilogrammes (about 105 lbs.) of water, suffice to keep the boiler dry for six months, and it is only necessary to open and examine it once a month. The chloride of calcium may be dried before an open fire, and used again.

**Process for Cutting Bars of Hardened Steel.**—Mr. REECE, of Detroit, in the United States, cuts hardened steel by means of a soft wrought iron disc a yard in diameter. This, having a rotary movement, with a velocity of 25,000 feet a minute at the circumference, easily cuts bars of steel two or three inches in diameter. Its friction heats the bar, and produces a real fusion at the point of contact. This may be proved by an examination of the metallic particles which continually fly round the disc during the operation. The disc and the bar are scarcely heated in other parts. *Revue Industrielle, Nov.* 17, 1875.

**Railways in Russia.**—The Russian Minister of Public Works has just submitted a proposal with regard to the construction of railways in the east and south-east of the empire. First comes the railway of the coal district by the Don, with numerous branches in the valley of the Donetz. Then follows the Siberian line, which will serve for the basin of the Volga. An imperial ukase is daily expected at Tiflis authorizing the construction of two lines in the Transcaucasian provinces. The first, of about 270 miles in length, will connect Tiflis with Djailfa on the Persian frontier. The second line, about 400 miles long, will go from Tiflis to Bakou and the Caspian Sea. It will pass through Skemakha and traverse the fertile province of Ghirvan. *Moniteur Industriel Belge, Dec.* 20, 1875.

**The first Railway in China.**—A Company was formed a few years ago in London for the introduction of railways into China. The first line to be constructed is one between Shangai and Woosung (at the mouth of the Shangai, on the Yang-tse-Kiung), about 9½ miles long. According to the "China Telegraph," the materials for this line have already been forwarded from London. The line will be opened next July, the breadth of the gauge being 2 ft. 6 in. There appears to be no doubt that the new line will have plenty of traffic, and the practical spirit of the Chinese will lead them to the extensive construction of railways in other parts of that vast empire. *Oesterreichische Monatsschrift für den Orient, Dec.* 15*th*, 1875.

### § 2. *Building, Decoration, &c.*

**Incombustibility and Impermeability of Wood.**—By dint of many chemical experiments, M. P. FOLACCI has discovered a means of rendering wood incombustible and impenetrable by water. After having undergone the process described below, it becomes petrified, so to speak, without, however, any change of appearance. On being subjected to intense burning heat, it becomes charred on the surface, but very slowly and without any flame, and it is only necessary to scratch the surface to find the substance of the wood intact. Hence, in case of fire, the firemen will have no occasion to fear that the flame will destroy the floors, doors, and staircases, if the wood of which they are made has been subjected to the chemical action he recommends. As to the flame of petroleum, it merely licks such wood without doing it any injury. Moreover, the wood by this means acquires a density which doubles its original weight. Lastly, the process renders it free from smell.

The following is the chemical compound that produces the above results :—

| | | | | | |
|---|---|---|---|---|---|
| Sulphate of zinc . . . | 25 | kilogrammes | (about | 55 | lbs. |
| American potash . . . | 10 | ,, | ,, | 22 | ,, |
| Alum, with ammoniacal base | 20 | ,, | ,, | 44 | ,, |
| Oxide of manganese . . | 10 | ,, | ,, | 22 | ,, |
| Sulphuric acid at 60° . . | 10 | ,, | ,, | 22 | ,, |
| River water . . . . | 25 | ,, | ,, | 55 | ,, |
| Total . . . . | 100 | | | 220 | lbs. |

The whole of the above solids, without the sulphuric acid, are to be poured into an iron boiler containing the above quantity of water, at the temperature of 45° Centigrade, or 113° Fahr. As soon as the substances are dissolved, the sulphuric acid should be poured in little by little, till all the substances are completely saturated.

For the preparation of the wood it should be placed in a suitable apparatus and arranged in various sizes, according to the different purposes for which it is intended, on iron gratings, care being taken that there is a space of about a centimetre (or ·39 in.) between every two pieces of wood. The above chemical compound is then to be pumped into the apparatus, and as soon as the vacant spaces are filled up it should be boiled for three hours. The wood must then be taken out of the apparatus, and laid out on wood grating in the open air to be rendered solid, after which it is fit for uses of all kinds, as ship-building, house-building, the manufacture of railway carriages and trucks, telegraph posts, wood paving—in short, in whatever cases there is any liability to destruction by fire. *Moniteur Industriel Belge.*

**Fire-proof Cement.** — Herr NEUENHEUSER, master builder at Sinzig, has composed a fire-proof cement which combines 93·05 per cent. of silicic acid with not quite 3 per cent. of clay. Mixed with water, it can be put into any form, and may be made of any strength. As with this cement every arch can be moulded of one piece, and dried by setting fire to the apparatus employed for the moulding, and at any time completely burnt through without showing any crack, the invention may be of importance for the construction of gas-stoves, blast-furnaces, welding-furnaces, &c. It may also be used for the walls of safes, and for fire-pots, &c. The composition of this cement nearly resembles that of dynas-stone. *Stummer's Ingenieur, Dec.* 10, 1875.

## THE USE AND ABUSE OF FUEL IN COOKING.

WE have reached a season of the year when the dearness of fuel becomes a matter of general interest and complaint; it is therefore a suitable time to touch upon the use of coal in cooking, and, we may add, upon its abuse or waste also. The voice of the public is never weary of upbraiding the miner, the coal owner, and the coal agent; each and all are reproached with turning the necessities of their customers to their own account, and realizing thereby extravagant profits; this branch of the subject we are not going to dwell upon; we do proceed, however, to treat this fuel question on other ground, for it must be evident to any thinker on the subject that a hundredweight of coal saved is one gained, and that, if coal is double price, the reasons for saving it are also doubled.

Much has been spoken and written upon the use of fuel in cooking and warming, and a certain degree of benefit has resulted; but yet much remains to be done. One of the greatest apostles of fuel economy was Count Rumford, who, by his researches into the laws of heat and its most advantageous employment, contributed greatly to improve upon the old-fashioned cooking appliances of his time; though his teachings have been but partially adopted, and the best we have done is to be found in the modern close range, which, in unskilled hands, is about as wasteful a contrivance as it is possible to produce. Count Rumford was an advocate, and, indeed, one of the progenitors of the

close range ; but his ideas were perfectly sound, and need only to be practically and properly carried out to make them realize all he desired. He very truly observed that every portion of air that entered the fire needlessly was a thief which stole a portion of heat and took it up the chimney, and with the view of preventing such loss instituted and carried out certain experiments with fuel, for the purpose of ascertaining the comparative cost of cooking with an open and with a closed fire. He found by these that a large boiler containing 28 gallons of water required 62½ lbs. of wood to boil the water, and to keep it boiling for two hours, when an open fire was used ; with a closed fire, it required only 13¾ lbs. Another set of experiments with a copper saucepan demonstrated that with an open fire 11½ lbs. of wood were consumed, as against 1¾ lbs. in a closed fire ; and he discovered that, generally speaking, five times as much heat was required with an open as contrasted with a closed fire-place. With the truest respect for Count Rumford and his doctrines, which in the abstract are sound, we are at the same time constrained to observe that he did not seem to realize so clearly as modern scientific men are forced to do, that it is not enough to demonstrate the soundness of a principle by means of contrivances which, however efficient if in skilled hands, are not well adapted for general purposes, but that it is also necessary to take account of the fact that the skilled and educated man has to devise means which the uneducated can use ; and it is, perhaps, almost needless for us to point out that in numerous instances the elaborate contrivance when in unskilled hands is ofttimes actually more wasteful than the ruder apparatus it is meant to supersede, and it is just as absurd an idea to commit a very elaborate close range, with its hot plate, ovens, dampers, &c., to the care of an ignorant and careless cookmaid, as it would be to commit a Long Acre landau to the care of a ploughboy.

Close kitchen ranges are excellent things, up to a certain point, and in good hands ; but for the average of servants in small establishments they are a great mistake—not one master

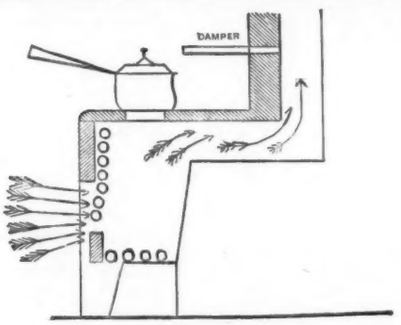



Fig. 1.

or mistress in twenty, much less their servant, are at all, however remotely, aware of the powerful engine that a close range is. In nearly all cases these ranges are in the basement of the houses, and even in two-storied houses the chimney is of sufficient height to create an intense draught, while in four or more storied houses the draught pressure is terribly excessive. Probably few of our readers are aware that a close range, with the door and register shut and the dampers open, becomes to all intents a smelting furnace. Heat is generated in one of these intense enough to melt cast and even wrought iron, and yet, at the very time this milk-white heat is glowing, it is hardly possible to boil a saucepan of water over it. We will explain why in a moment ; but we now just advise any of our readers to try the experiment, when, unless the grate happen to be quite full up of fuel, and that the hot plate be removed, they will find we are correct.

It is as well, before we proceed to point out the defects of existing patterns of range, that we first lightly sketch out the principles involved in the question under notice. The atmosphere around us is composed of the two gases, oxygen and hydrogen ; the oxygen has an eager affinity for the carbon of the coal or other fuel, and forms chemical combination with it, producing carbonic acid and carbonic oxide, and evolving heat in these formations, and these while heated and expanded, are lighter than cold air, and consequently ascend, air rushing in below to supply the vacuum. The heat evolved is of two kinds, (*a*) radiant, (*b*) direct ; the former alone is sensible in the front of the grate, such as toasts bread to wit ; the other, combined with radiant heat, boils the water in the saucepan over the fuel. This same agent, heat, no matter of which kind, is readily absorbed by some gases or substances, and in a less degree by others, while not at all by others ; ordinary air, for example, if moderately dry, absorbs it but slowly ; damp air—or more strictly speaking, air containing excess of moisture—absorbs it greedily. Metallic substances absorb and transmit or conduct heat more or less rapidly according as the heat impinges or strikes direct, or else merely passes along, above, beside, or beneath the surface. Practically, no heat is imparted to the plate beneath, and but a little is transmitted sideways, more than 80 per cent. of the whole goes upwards, unless there is a side motion, and then the heat only on the outer verge of the gases with which it comes

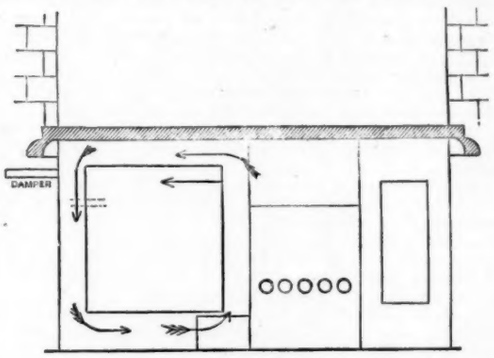



Fig. 2.

from the furnace passes through the plate, owing to what we have just stated, that dry gas or air conducts heat very slowly. Count Rumford, when he began his researches, was high in command in the Bavarian army under Prince Maximilian, and he was called on also to perform other State duties as well ; one plague spot in particular was festering in Munich at this time, viz., professional mendicancy. Rumford turned his soldiers into policemen, and with the co-operation of the town authorities he arrested and registered every beggar he could find ; he then established industrial workhouses for them, and being called on

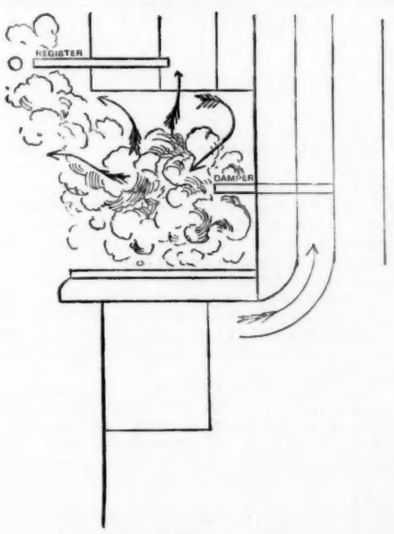



Fig. 3.

of course, to find food for them, had his attention turned to the saving of fuel in cooking for about 2,600 paupers. He found then that the existing fire-places being mere hearths, with andirons or "dogs," were terribly wasteful, and he, bringing his scientific attainments to bear, conceived the idea of the close fire-place or range, simply to confine the heat, which heat he conducted through sundry flues around roasting ovens and boilers, much as in modern ranges, and subsequently allowed the products of combustion to escape up the chimney.

We now reach the point where all this is applied in existing kitchens, and, though the principle of thus conducting the air

through crooked passages is theoretically correct, we have to show the reasons why in practice such ranges are often, indeed nearly always, more wasteful of fuel than open fire-places, and we invite attention to the annexed sketches, which show in two sections, viz., front and side, an ordinary close range, and we will, as we promised above, explain why it is that, with more than enough heat within a few inches to cook a joint, we yet can scarce boil an egg.

If our readers will look at sketch, fig. 1, they will there see what takes place in the attempt to boil water over one of the holes of a close range, on the hot plate. There is, it is true, a glowing furnace beneath, yet the water don't heat, simply because there is a violent rush of cold air passing rapidly along between the fuel and the hot plate; the process is to all intents the same as though one person, raising a morsel to his mouth, had it snatched from his fork at his very lips by another.

We have said above that heated air passing along a plate yields but little heat to it; matters are much worse when a current of cold air passes between the heat and the plate. When this sort of thing takes place, the servant will, if she be tolerably intelligent, close the damper A, fig. 3, and open B. And here is where theory is at variance with practice; an interval of some feet of open space intervenes between the hot plate and the mouth, C, of the register flue; the products of combustion get cooled crossing this, and, losing much of their volatile character, rise but languidly, only to break on the edges of C, and, while a portion goes on up the chimney, the rest turns out into the kitchen. Some ranges have a movable plate here to obviate this evil; but, if this plate be touched, woe betide! there is probably a month's accumulation of soot over it, and if it is stirred this is impartially distributed over the hot plate and everything thereon. It will be said, "Screw the fire upwards:" this does little good; even if the fuel touch the saucepan, there is still the evil of the current of cold air between, the only difference being, that it passes through instead of over the fuel. If the heat would ascend straight upwards, and not turn aside into the flue, and that the smoke would do just the reverse, then, indeed, a close range would be very near perfection; but this can never be with present arrangements. In the open range a saucepan can be placed directly on the fire; the draught is not intense, and, although heat is wasted, much of it wastes at least into the kitchen instead of up the chimney; and, as the fire is mostly used in winter, this is rather an advantage than otherwise. The truth is that, although a close range will roast and bake moderately well, it will not boil at all without an extravagant consumption of fuel. The boiler is all very well for hot water, but no cooking by boiling can be done cheaply with a close range, and for the simple reason, that for boiling a moderately slow fire is the best, and the draught must be *upwards*, so as to cause the heat to act to the best advantage; side heat is utterly useless for cooking by boiling, and side heats are alone what can be had in the close ranges. Matters are made worse by another fact, which in cooking ranges for large establishments receives some attention, but none at all in any others, viz. that the range maker and the "pots and pans" maker never take the least trouble to make their respective wares suit each other. Nothing on earth can be more preposterous than the scheme for boiling water as exemplified in any kitchen with a close range, consisting as it does of a plate of metal, beneath which burns a raging furnace, a violent current of cold air rushing between the two; the little door being shut in front only intensifies the draught up the chimney, without mending the evil: in the plate a large hole is pierced, and over this is set the kettle or saucepan, the childish, ridiculous idea being that the water will boil,—"Is it not over a furnace that will melt iron as wax? so the water will soon boil." So it would, were it not for Count Rumford's thieves, which rush between and steal the heat, and bear it off to utter, hopeless waste. The action going on between the fire and the saucepan bottom is exactly analogous to that which constituted the torments of Tantalus, before whose lips flowed water, but never a drop for him.

Having pointed out a few of the leading faults of the close range, we must proceed to suggest remedies for them, and to do this we must say a word first concerning open ranges. We never could properly imagine the causes of prejudice to the open fire-place for cooking, and, beyond the vague assertions that it was dirtier and more wasteful than the close range, we never have discovered or learnt any valid objection. Our own conclusion is this, that the old-fashioned open fire-place, big enough to hold a sack of coals, no doubt is a dreadful affair to contemplate, but wonder when will the general public learn the fact that coal-burning is quite independent of the *size* of the grate. Given two grates, one, say, four times the capacity of the other, but with flue arrangements that will force six times as much air through the small grate as that which the flue of the large grate forces through it, then the small grate will burn six times as much coal as its companion; where, then, is the economy? It is true that, as the two stand in the show-room, or fixed fireless in their kitchens, the little one is the most favourably regarded; but a bulldog is much smaller than a bloodhound, yet it is all the odds that the former wins the fight. First, as to the objection that the open range is the dirtier; that means that it gives in this respect the most trouble. Next that it wastes coal; it need not be allowed to do so if the sliding "nigger" be screwed up. Miss Sally Brass, we are told in the "Old Curiosity Shop," achieved great economy with this contrivance. The grate in a proper open range is not so deep as in the close range. In the former the fire is longer and shallower than in the other, and it seems that, if jack-roasting is to be done, there is a greater quantity of coals to be put down. If we ask why, we are told that, as the grate is shallow, the fire must be long. This is puerile argument; it means that in the close range the fire is on end, and in the open on side; the quantity, we apprehend, may be alike. The question remaining, then, is—which is the best roaster? and we assert the latter ought to be, and is, for the draughts acting on it are more moderate, and the heat is, therefore, not blown away up the chimney.

Now, to make a concluding suggestion or two, first let close-range makers remember that the commonest and most constantly employed department of cooking is *boiling*—not getting hot water, but *boiling*. Let them, therefore, make their close ranges with facilities for boiling. This they can do (*a*) by putting convenient handles to the hot plate, in which hand hooks can be put to remove or replace it, and not leave the task to the tongs; (*b*) let all close ranges have the bottom made to screw up and down; (*c*) let the mouth C (fig. 3) be greatly enlarged to a conical shape, so as to gather in all the smoke; (*d*) let kettles and saucepans be made to fit or correspond with the shape of the grate; let them be made square, for example, to fit the square grate, and the handles be so fitted as not to interfere with their being placed on the fire to the best advantage. If only a few trifles like these were attended to, a range might easily be devised which would combine most of the good qualities of both the close and the open range, and eliminate many of their present objectionable features.

## BOOKCASE AT THE PALACE OF MARIENBURG.

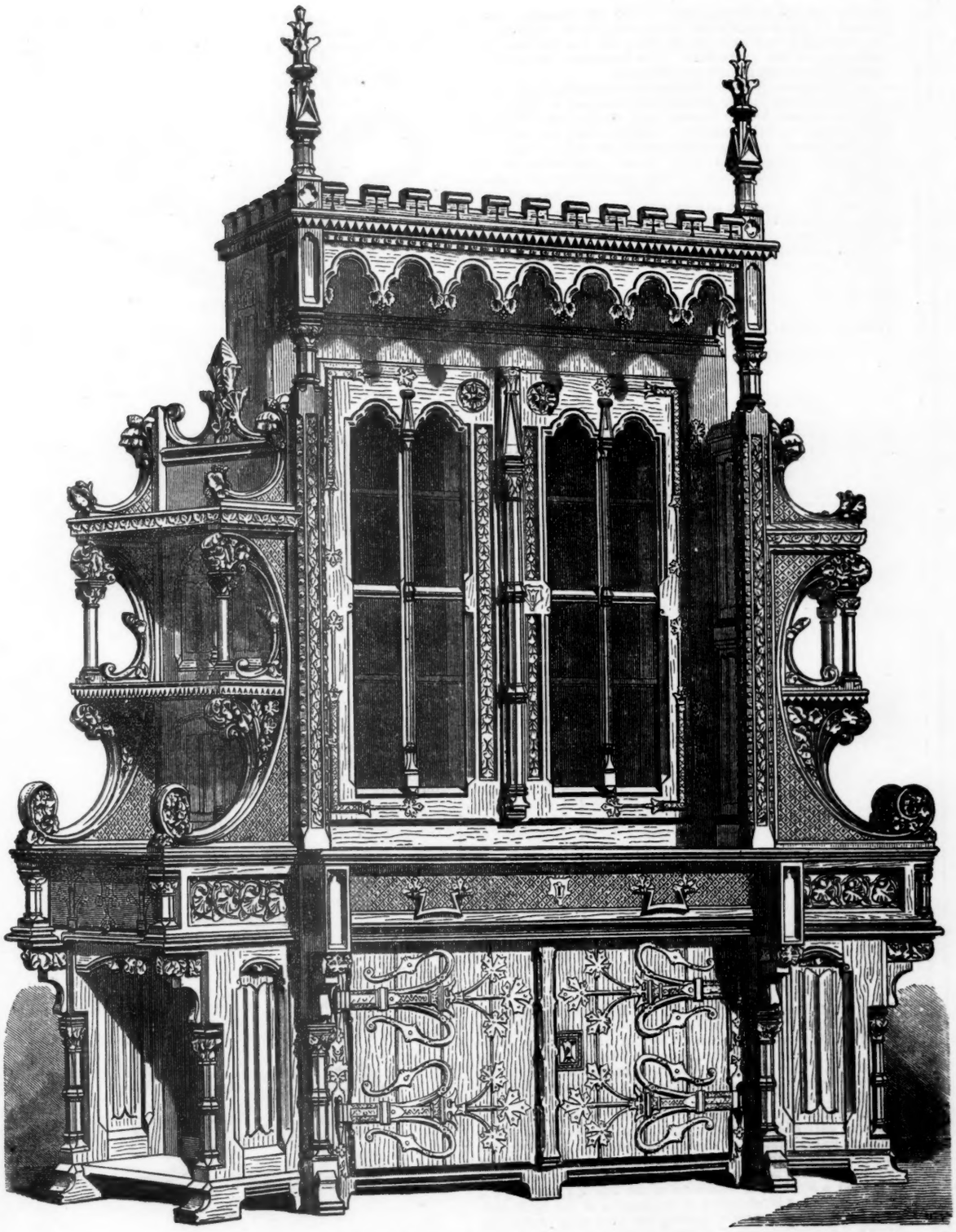
DESIGNED BY OPPLER, ARCHITECT, OF HANOVER.

THE Library of the Palace of Marienburg is situated in a round tower, in the centre of which rises a column supporting the fan-like ceiling of the compartment. The bookcases stand by the window-frames between the windows. Diagonal corners are thus left between the cases and frames; these are filled up by *étagères* and are utilized for the reception of albums, atlases, &c. These cases, eight in number, are executed by Bahre, carpenter, of Hanover, in solid oak.

## TOOL FOR RIVETING BOILER TUBES.

OUR respected contemporary, *La Métallurgie*, supplies us with a description of a tube-riveting tool invented some time since by M. Jouffret, engineer of the Doubes and South Eastern Railway of France, and for which a medal was awarded by the Society of Industrial Sciences of Lyons. M. Jouffret, like many other engineers, recognized the difficulties and imperfections of the usual methods of riveting boiler tubes, and especially the fact that the effect of the hammer or other tool was often to shake a joint which had already been made and supposed perfect.

The apparatus in question consists of three steel runners or wheels, the peripheries of which are turned concave of the form desired to be given to the edge of the tube; these wheels are attached to a strong stock of which the parts are so arranged that the runners can be set to any sized tube by the action of a screw and nut. The tube being placed in position in the plate, with its end projecting from 7 to 8 milimetres, more or less, according to the circumstances of the case. If a ferrule is to be inserted in the end of the tube this is also fixed in its place, if not, a mandril supplies its place during the action of the tool. Thus the runners are equi-distant, and tangentile to the ring or mandril. All the parts being in position, the tool is caused to



BOOKCASE AT THE PALACE OF MARIENBURG.

revolve around a central arbour, and the runners pressing heavily on the protruded end of the tube rivet it completely and regularly all round, while neither the plate nor the tube being submitted to any shock there is no distortion and no disturbance of the riveting when once effected.

The inventor says that the work is done more rapidly by the new tool than by the old method; that an end is riveted by it in five minutes by the former, while the old method occupies from seven to eight minutes. Unfortunately, the tool is not applicable to the riveting of the tubes in the angles of locomotive boilers, but it is observed that these are subjected to the least wear. It is available for the central mass of tubes, and for the lower range, which are acted on directly by the fire, and which, consequently, should be riveted with the greatest possible care, especially in boilers, such as those of locomotives in which the tubes act, to a certain extent, as ties between the tube-plates and the smoke-box. The tool is said not to be very dear. *Iron.*

## THE PRACTICAL NOTE-BOOK OF TECHNICAL INFORMATION USEFUL TO STUDENTS AND WORKMEN.

(103.)

**ELEMENTARY Lessons in Drawing. Section A. Projection applied to the preparation of working Drawings.**—Before taking up the subject of the projection of bodies at angles to the planes of projection and of circular lines and bodies, we shall finish our illustrations of sections, begun in our last note, under

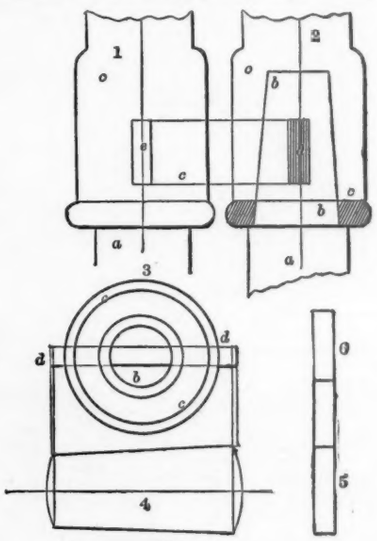



Fig. 597.

the present heading. In fig. 596 we illustrate the junction of the foot of "king post," *a a*, with the "tie beam" *b b*, of a roof, the two being secured by an iron "strap" *c c*, the strap and timber being held together by the "king" and "gibs" *e e*. The section to the right hand, with the corresponding letters, will show how the parts are joined together; and the forms of the king and gibs in fig. 597, at 1 "part elsewhere," and at 2 "section," and at 3 "plan" of lower part of 1 and 2, of part of an eccentric strap to which the end *a* of the eccentric rod is attached. The end of the rod *a* passes up the hollow end *b b* of the part *c c*, and is secured by the "key" or "cottar" *d* which passes through the slot *e* of *c c* in 1 and *d* in 2 of the rod, *a a*. In 4 a front view of the key is given, in 3 *d d* is its edge view, 5 is elevation of the large, 6 of the small, end. In fig. 598, *A* is front view, showing the face of a "cottar" or "key," *B* the edge view, *C D* the face views of two "gibs," *E* being edge view of *C*, and *F* ditto of *D*. *G* is only one side of *A*, *H* side view of it. In fig. E, *A A* is section and *B B* elevations of an angle iron, *a a* joining two pieces of plate-iron, *b b*, *c c*, at right angles to each other, the whole being riveted together, by rivets as *d d*.

In fig. 599 we give in *A A*, section *B B*, elevations of two parts of iron plates *b b*, *c c*—at right angles to each other—joined by an angle iron *a a*, the whole being secured by rivets *d d*.

Fig. 601.

Simple as these illustrations and those which have been given in preceding notes appear, the student in projection must not suppose that they convey no lessons of practical value; on the contrary, they are specially designed to illustrate the fundamental principles of the art. They should be carefully studied,

Fig. 602.

and the relation which one part bears to another clearly understood. The value of understanding what the young student is too apt to slip over as being so simple in appearance as to be below his notice, and unworthy at least of his close and earnest attention, will be seen as we proceed, and as we place before him

Fig. 603.

complicated subjects which will demand and require this attention on his part before he can master them. Let it ever be remembered by the beginner that, to ensure a safe and sound structure, the foundation must be well laid; a building beautiful in its proportions, striking in its magnificence, is but,

Fig. 604.

after all, composed of single bricks and stones, each in itself a very plain and simple-looking object, but the fine building, and which strikes his fancy or ministers to his notions of the grand and the beautiful, could not have had existence had not these simple bricks or stones been placed together upon a

Fig. 605.

system founded upon correct and sound principles. These remarks will appear, as indeed they are, but commonplace truisms, but it is just those which are apt to be neglected or overlooked to the great loss and often detriment of students of any branch

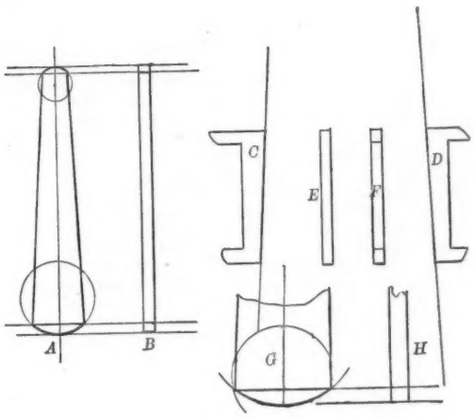



Fig. 598.

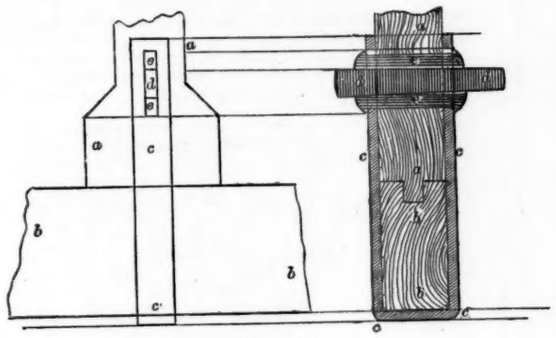


Fig. 596.

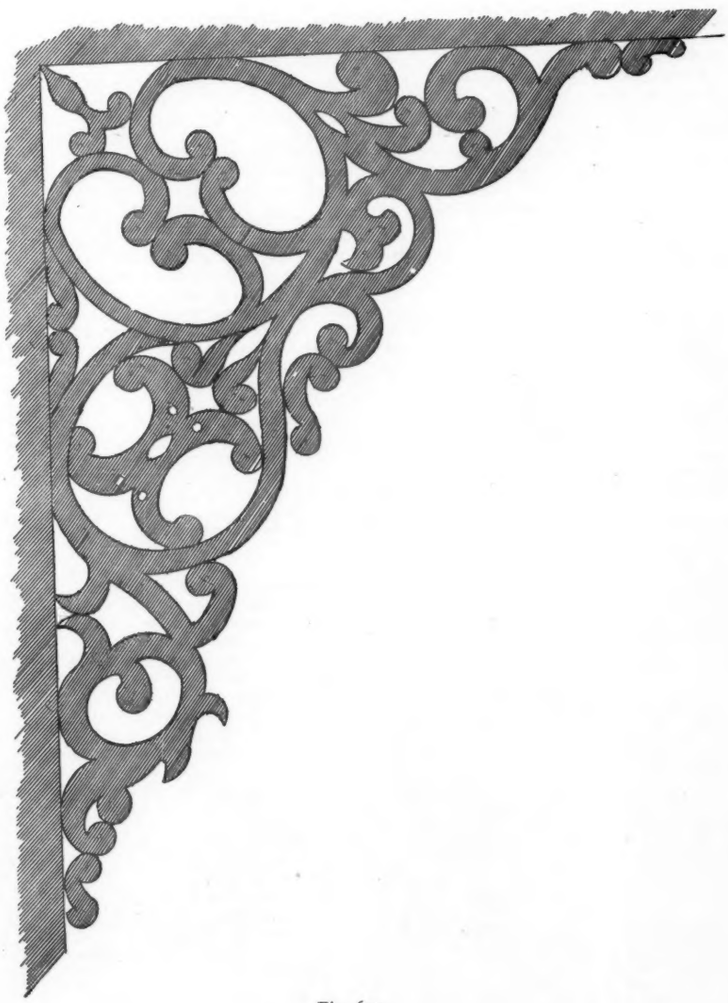


Fig. 607.

Fig. 600.

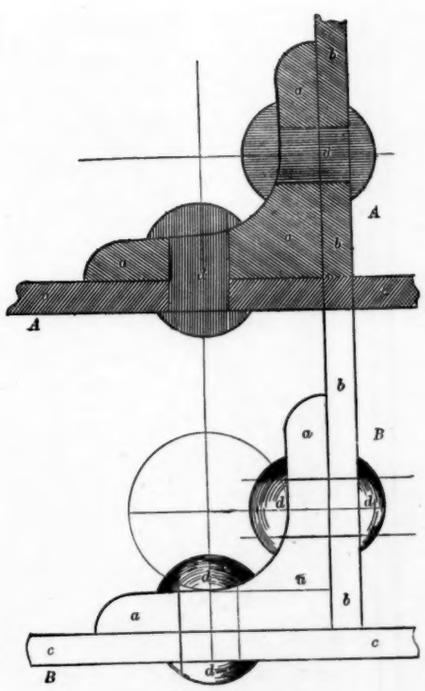



Fig. 599.

of art or science, hence the reason why we have drawn special attention to them.

(104.) **Ornamental Cut Woodwork.**—In continuation of this department of our notes, we give various suggestive elementary designs, in figs. 600 to 605; of a "finial" in fig. 606, and a bracket in fig. 607. To those of our readers who commence the work with this new volume, we would direct attention to the first articles under this heading given in the first volume of the

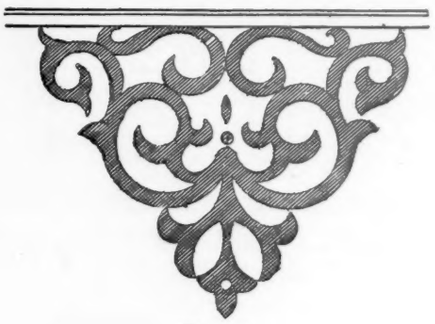


Fig. 606.

"Practical Magazine," as giving ample instructions how to find the "centres and working lines" of various designs. We here take it to be a fitting opportunity to announce our intention to commence, most probably in our next, but at all events, in a very early number, a "new series," in which we hope to present some practical novelties still more attractive and useful than, we are glad to say, the first series proved to be to a large majority of our readers.

## FABRICATION OF SUGAR WITHOUT PRODUCTION OF MOLASSES.

IN connection with the discovery of M. LOUIS JUIRE-REY of a process by which sugar can be extracted without the production of molasses—a process which we are now informed is equally applicable to the extraction of beet as well as cane-sugars, and to all kinds of refining—our Spanish contemporary, "La Lealtad," by whom the discovery was first announced, gives some extracts from the "Boletin Mercantil" of Porto Rico, showing that the planters of the Spanish Antilles have been more alive to the importance of the invention than sugar-refiners nearer home.

"By the last mail," writes the "Boletin," "we received a communication, with inclosures, to which we would earnestly invite the attention of our planters. If the marvellous discovery therein announced prove a reality, and if the island of Porto Rico adopts the same, the sugar difficulty vanishes, and the supply of that precious commodity in all the markets of the world will be doubled. It is asserted that the process provides a sugar unaccompanied by molasses—a sugar in which various matters heretofore deemed uncrystallizable are crystallized, which contains every particle of saccharine juice resident in the cane, and requires but one-half of the present outlay on fuel, besides admitting of an important reduction in the cost of buildings and plant. Whether this assertion be correct must be learned from the inventor himself. He says that, having invested his whole fortune in experiments extending over a period of twelve years, and resulting in the discovery now in his possession, he would require, in the event of its introduction in the colonies, to have the means provided for defraying the cost of passage thither of himself and family, and of living there in a modest style until the result of his discovery should be seen, being content to receive payment for his invention out of the surplus profits realized by those adopting his system.

Taking the most unfavourable view of the case—that the 2,000 or 3,000 dollars required to pay the inventor's expenses here give us nothing in return, what would be the loss divided among the twenty or thirty growers who might be got to subscribe the amount, all of them deeply interested in its possible results? Isabel the Catholic paid far more to Columbus when she gave him 20,000 dollars to defray the expenses of his first voyage, and the result was the discovery of a new world. The project of M. Juire-Rey is scarcely less stupendous.

A radical revolution in the sugar industry, to destroy at one fell swoop the whole lucrative business of sugar refining in Europe in the interests of the Antilles, which hereafter would be enabled to send out sugar white as the driven snow, and in quantity doubling all previous exports, to any part of the world where a market could be found. Of the inventor and his personal antecedents we know nothing. But when we find the leading journal of Granada, one of the chief centres of the Spanish sugar trade, inserting his statements in its editorial columns and commending them to notice, when we find that the samples of produce presented by him obtained honourable mention at the local exhibition of the noble Moorish city, it would be absurd to call in question the technical skill and experience which so largely characterizes the memoir in question."

The "Boletin" recommends those of its readers who may be in doubt as to the applicability of the method to the plant at present in use to address themselves individually or collectively to the inventor, at his residence, No. 2, Calle de la Alhondiga, Granada.

It adds that a copy of his memoir on sugar has been forwarded by M. Juire-Rey to the "Diario de la Marina" of Havanna, and concludes with the hope that Porto Rico, unembarrassed by the difficulties of the sister island, may not be behind in availing itself of this most promising invention, which is again earnestly commended to the reader's notice with heartiest wishes for its success.

## THE STUDIES AND DISCIPLINE PREPARATORY TO THE PRACTICE OF THE TECHNICAL PROFESSIONS.

### No. II.

BEFORE taking up the consideration of any special branch of the many professions which, more or less fully treated of, will demand our attention, we deem it necessary, or at all events likely to be useful, to glance at a few points which are of a general nature. To some, indeed, of our readers, what we have under this head to say may appear to be too general; but it will be seen, as we proceed, that they have a very close and a very practical bearing upon the subject under discussion.

To begin, then, at the beginning, it may be said that the education of a youth destined to follow out one of the many technical professions which offer themselves to the notice of parents and guardians, cannot be begun too soon. Of course, there is a limit to this statement. For example, it is obvious that the youth must be so far advanced in life that his "liking," as the phrase goes, for any particular branch will not be likely to be mistaken for one of those "boyish whims" or "youthful fancies" which crop up so frequently—too frequently—with some, that it is difficult to say what his real liking is, and how long before the old fancy will be displaced by a new one. We should say that, as a rule, "likings," for any of the professions in which mechanics—and we should perhaps have said chemistry—are concerned, show themselves at earlier ages than do others, and in a way so decided, that there can be little chance of misunderstanding the "bent of the boy's mind." A "mechanical turn," as the phrase goes, shows itself very soon, and often to the great annoyance of the housekeeping part of the family, and not seldom to that of "Paterfamilias" himself, developes or displays itself in a variety of ways, which, while it detracts from the "tidiness" of the house, converts many of the "household gods," and much of the household gear, into uses very far removed from their original uses, in the attempts, not always successful, of the youthful little engineer or architect to create some wondrous invention or design out of such very unlikely and unpromising appliances. But, be this as it may, and whether it be true or not that the boy's liking for the mechanical professions developes itself earlier, and in a way so decided that it cannot be mistaken, than it does for some others which might be named here, what we have said still remains true—that a youth's education cannot be begun too soon. We shall, of course, be met here with the question, "But what is education?" We can do no more than at present reply, The answer to *that* involves all the points which we have as yet to consider, nay, constitutes, or will constitute, the series of papers, or rather, that which will be given in them, which we have just begun. The answer, therefore, will be—must be—given by degrees, and opened up as we proceed. We of course

can state this much, that the "education" consists of two great divisions—first, that which is preliminary to entering the "office" or the "works;" and, second, that which is carried on in the latter.

It is of the preliminary or preparatory education that we have above said so much, and of which we have yet to say somewhat more. This part of the preliminary education is made up, or we conceive it to be made up, in the case—for example—of the boy who has shown what is termed and so popularly known as a "mechanical turn," by the very trials, experiments, and attempts which the boy makes in his endeavours to realize some "dream of his" to make some machine, or do, in fact, something great which no one has done before. Now, perplexing as these attempts are, as we have already hinted at, to the older heads of the household, and destructive of not a little material otherwise more valuable, still we should by all means counsel the parents not to be "too hard" upon the inventive youth, not to be "down upon him," as the rough but very graphic phrase puts it, at every little escapade of the boy, even although that should result in the destruction of a kitchen clock in the attempt to make some engine of wondrous power and mechanical efficacy, the thinking over of which has perhaps kept the young engineer awake for nights; or what may be still worse, because more dangerous, if the house should be nearly set on fire, or the windows blown out, the practical result of the trial of a new furnace or a steam boiler. Paterfamilias must overlook such things in the correct consciousness that, although in a peculiar way and one not always to his liking, the boy is being educated, that he is learning many a thing, discovering what to him is new, acquiring habits of deeply—for a boy—thinking over many points, all which in some way or another will show themselves in after-life to have been by no means useless and only developments of mischief. Nor, if the youth's "proclivity" burst out in a liking for chemistry, must "Materfamilias" get wrathful at holes showing themselves in clothes, garments, and in household gear where, acccording to all the rules of good housewifery, "no holes should be," nor if articles of vertu and expensive or tasteful table appliances be put to uses which their designers never intended they should be put to. All these things, and many still more absurd and awkward than these, will come out in the lives of youths, and we are quite of Christopher North's way of thinking, that, even apart from the fact that such escapades do form part of the "preliminary" education of youth, a lad is not of the true metal who does not get into mischief, or, to put it in another way, he is not worth a button who does not either by steam, gunpowder, or some wonderful chemical combination which he has—to his own astonishment doubtless—invented, blown his buttons off, and very nearly the body which these buttons adorned.

One moral of all this the older reader will have perceived by this time,—that, once the bent of the boy's mind is fairly indicated, that bent should not only *not* be thwarted and opposed, but be encouraged, and, in order to avoid some of the mishaps we have hinted at, all legitimate means be put in his way by which he can cultivate his liking, and develop it in the thousand and one ways which a boy alone can think of and which a boy alone can do. In point of fact, once the mind of the youth is fairly made up to "be so and so," there is nothing practical to be gained by thwarting his liking, everything in point of fact to be lost; but on this we shall have somewhat more to say in its proper place.

We have advised parents to give not only every encouragement to the youths to "try their hands" at working this and making that where the turn of mind is towards mechanics, or in the carrying out of experiments where it is towards chemistry, for example, but to give him every facility for doing these in a consistent, legitimate way. And this, not only because he may be thus, although imperceptibly, yet still certainly acquiring some habits to which we have briefly alluded, and which will prove useful to him in after-life. But this preliminary education may be yet further extended, and in this way—that while all reasonable helps are afforded to the youth to carry out his experiments" and to endeavour to realize his "schemes," it must be insisted upon that, while thus encouraged, he must cultivate the habit of finishing one thing before he begins another; let what he is attempting be proved to be either a failure or a success—such as it may be—but let it be shown to be either one thing or another, and let all work begun be fairly finished. This habit established will of itself be of immense value to the youth in after-life: and no one but can see that as part of the preliminary education it possesses the greatest advantages. But not only should this be insisted upon, but also that all the work be as neatly done as possible. Some boys have naturally slovenly, careless ways of doing everything they put their hand to; this can to a large extent be overcome, even at this early stage, by instituting a species of reward for work neatly done. Others again have just as strongly developed a habit of finishing off things neatly, and we have seen as the work of boys that which would not have disgraced accomplished and experienced men. By attention to these points even during the hours of play, much may be done which will be of service to the boy when he is called upon to do the work of a man. It will, after all, be but a fair bargain for the parent to make with his son as thus, "I shall supply you with all that is necessary to carry out your schemes; all I want to be paid for so doing is to see that you finish whatever you begin, and that all you do is done as neatly and orderly as you can do it." Another point of this department of education should be, that, for a time at least, one branch only be followed out at a time. The habit of rushing from one thing to another, doing a little at each, but not much of anything, is most pernicious, and should be checked. Thus, even in the earliest stages of what we have designated as preliminary education, and what many would, and to a large extent justly so, call the play or recreation of the youth, may habits be begun to be formed which will be of singular service to him in after-life.

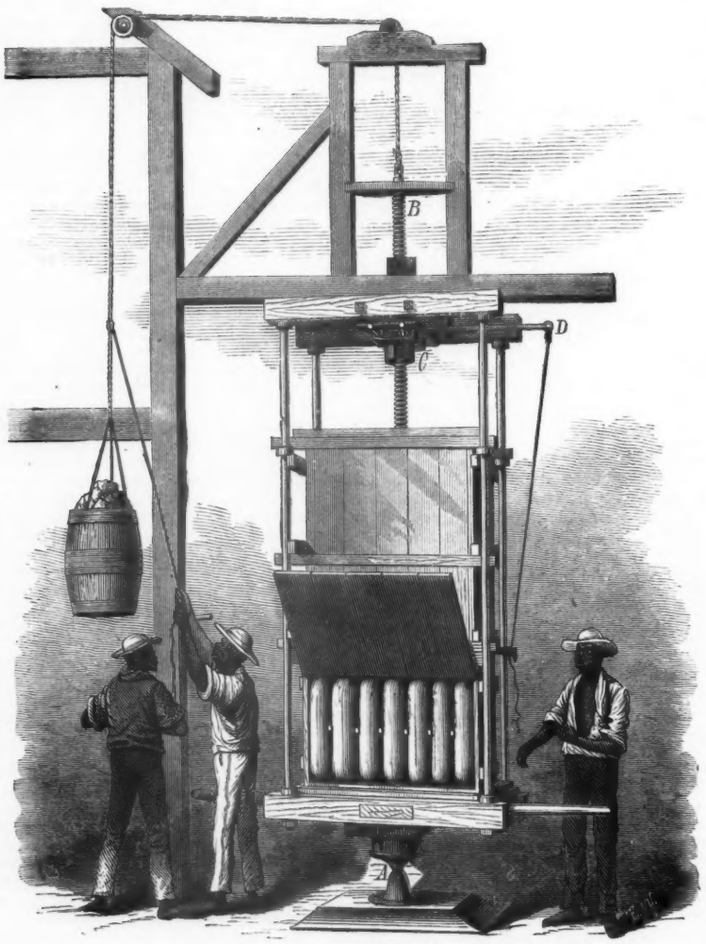
Another point which the parents should keep in view is getting the youth to trust as much as possible to himself in his "recreative work," if we may so call it. Youths have a wonderful facility for picking up acquaintances amongst the neighbouring work folks, or, if his parents are wealthy and have lots of assistants about the place, ten to one some one amongst them will be very much more inclined to while away an hour or two pretty often with "Master Tom" than to attend to their own proper duties, and show in helping "Master Tom" in one or other of his schemes really more skill than they do in their own department. Hence the youth is too often inclined to fall back upon the help he can get from others to assist him out of his difficulties than he ought to do. This habit of "trusting to others" is another of those bad ones which should be checked, and, if it happily be so, it also will prove of invaluable service to him in after-life.

We have said that not only should the desire of the youth for experimenting be encouraged, but that he should be supplied constantly with appliances which will enable him to carry these out. This last must be taken with a reservation—for although the position it leaves him in may result in his using, as we have already hinted at, some of the "household gear" not previously designed for such work; still, by not being too freely supplied with a variety of materials—paid for, perhaps, by his over-indulgent father—he will be thrown upon his own resources. And, candidly speaking, we should be much more pleased to see a boy of ours show a real cleverness in appropriating what to our eyes would be a most unlikely household appliance to the carrying out of his own scheme, than angry at him for in so doing perhaps irretrievably ruining some special favourite of the household gear. It is really worthy of remembrance that there may be as much true ingenuity shown in finding out and appropriating unlikely things for the carrying out of schemes than in the invention—if the term may here be applied—of the schemes themselves. The habit of "making the best of everything," and of making resources of help in times of emergency, is most valuable in after-life, and is that, indeed, which often distinguishes the eminently clever man from him who goes on by mere routine. In proof of this we could cite many instances where professional men have on emergencies, by availing themselves of what was then and there ready at hand, and availing themselves of them smartly and appropriately, shown themselves to be men of the true stamp, of the right genius, and more strikingly than under other more favourable and calmer circumstances.

We have begun our more special remarks by citing cases which belong to the very earliest period of preliminary education, so early that, as we have said, many would call it "play," and nothing more; but we have done so with a purpose to show that, if this "play," if it be such, is wisely conducted and looked after, it may form the means of affording opportunities of inculcating habits which will be of vast service to the youth in after-life, and although we have, in doing so, drawn our illustrations chiefly from one or two of the professions, it is obvious that they are alike applicable to all. Those useful, nay, invaluable habits, moreover, may and should be insensibly taught, for of all things deserving of the horror of right-thinking men is a "priggish boy;" but if our remarks have been read aright, it will be seen that the principles which they involve will have no tendency to bring up youths as "prigs and precise young gentlemen"—quite the contrary.

We have said that the "liking" of the youth should not be gone against by the parents, and this, however much it may clash with their own fondly cherished schemes for the boy's advancement. The mere attempt to force his liking into the channel of theirs is sure to sour his temper, and have, in every respect, a bad influence upon his character. And, although he may be at last forced to be what his own will revolts against, no true

gain will be the result. Let, therefore, the youth have his own will as to what he is "to be." We have known cases of what we do not hesitate to call the grossest domestic tyranny exercised by parents forcing their sons to be what their "inmost souls loathed and detested," some of these ending in the ultimate ruin of more than one of the boys. Indeed, it is only in cases where the youths are possessed of a high degree of moral culture and "rectitude of soul," that they keep to their duty; but who knows at what mental sacrifice this duty is done? We know of nothing more cruel than that system, too often acted upon, of forcing youths to follow callings they detest, merely because the parents believe that in these callings lies the surest chance of success—that they know "Mr. So-and-so will be sure to look after Tom, if he will only enter his works or his office." Better—a thousand times better—to sacrifice this or those advantages, too often delusive and fancied, and but seldom realized, than to sacrifice the happiness for life of the youth, who never will, as a rule, take heartily to the following out of the details of a calling which he dislikes in every way.




BALANCED SCREW AND REVOLVING COTTON PRESS.

THE several points of merit claimed for the improved cotton press herewith illustrated are simplicity of construction, rapidity, and reliability of action, and the saving in time of pressing effected. These, with other advantages below noted, combine to render the device suitable for employment by cotton raisers, or applicable to the pressing of tobacco, hay, hops, cloth, paper, hair, hemp, moss, cider, wine, rags, straw, and, in brief, to any operation where inventions of similar nature are now employed.

The apparatus, as shown in the illustration, revolves on the pivot, A. The screw, B, having a crosshead which travels in the guides on the upper part of the frame, extends down through a nut, C, on the revolving portion. To the upper portion of the screw is attached a cord, which, passing over suitable pulleys, carries a barrel of stones or similar counterpoise.

The nut, C, is made in two sections which, by means of the lever attachment, D, may be closed together or opened at will. When the parts are closed and the lower portion of the press rotated on its pivot, by means of the handles shown, the screw, acting on the nut, is necessarily caused to travel downwards, so forcing down the follower and compressing the material. When the pressure is finished, instead of it being necessary to turn the press in the opposite direction, and so waste time in raising the screw to its former position, the sections of the nut are opened, releasing their engagement with the screw, which is then lifted bodily by pulling down on the counter weight, as represented in the figures on the left. It is claimed that, through the economy of time thus effected, one third more bales per day can be pressed. After the cotton box is filled, the follower block does not require to be turned down three or four feet before reaching the point at which pressure begins, but is lowered or dropped at once, so that the real work commences with the first revolution of the machine.

The press, if desired, can be run by steam power, a belt being placed on the drum under the cotton box. It can be located in

the lint room or erected as shown in the engraving, by framing a supporting beam into the gin house and allowing the apparatus to stand near to and outside of the buildings. The frame is of iron or wood, as desired, is portable, and occupies no extra space. Five hundred pound bales are readily made with two hands, or animal power may be applied if required.

By a slight change in the adjustment of the nut, the machine can be converted into a tramper press, the screw and follower being used to pound the lint in the box down into its place, thus obviating the injury to the health of the workers who enter the receptacle and tramp the material with their feet. *Scientific American.*

USING THE RAW MATERIAL TO THE UTMOST.—One of the greatest discoveries ever chronicled is that of petroleum. Its importance is even yet but half comprehended. Nature's economy, in all of her productions, is in no instance more strikingly illustrated than the varied merchantable commodities that are wrought from crude oils that are so bountifully deposited in some sections of America, and the great waste that attended its treatment would do for an excellent text for a telling sermon on the startling ignorance of man and its rapid disappearance under the incisive application of his intellect. Upon the first discovery of the oil in the Pennsylvania districts, of course immense quantities were lost while yet in a crude state, owing to the inadequate means and contrivances for preserving it; then in treating the product the residue in the stills of the refiner was regarded as fit only for fuel. This was, however, soon found to be an error, and the tar was taken from the oil refinery, submitted to another treatment, and parafine oil is the result. Again a residuum was found, and this, in its turn, is now pressed and refined, and enters largely into the manufacture of candles. Submitted to a still further treatment, the wax becomes a transparent and tasteless mass, in which condition it is converted into chewing gum. After undergoing all these varied treatments, there still remains a hard, crisp cinder, which still contains sufficient live matter to render it combustible and fully equal to the best coal in its heating qualities, and this, notwithstanding the fact that in its latter treatment the mass is submitted to a white heat, which one would naturally suppose would so thoroughly disintegrate the matter and render any residue unfit for any purpose, much less a fuel. What science may yet accomplish in drawing from this cinder an article to swell the list of analogous products, is as yet undetermined; but we are not prepared to believe that even this mass, although it leaves scarcely a vestige of ash, after being burned as a fuel, will be allowed to go to waste. *Journal of Applied Science.*

## ELECTRO-DEPOSITION OF IRON.

AN interesting paper was read by M. Volger before the Frankfort Society of the Physical Sciences last autumn, which we have not seen properly noticed in England, and from which we extract the following notes relative to the treatment of iron.

Forty years ago M. Peligot succeeded in reducing chloride of iron by means of hydrogen gas, obtaining regulus of iron in octahedric crystals; and he also succeeded in preparing small malleable plates.

In 1846, M. Boettger succeeded in decomposing chloride of iron by galvanism, but he soon found that a mixture of ammoniacal sulphate and chloride of iron was more advantageous for the purpose, and he prepared this mixture very simply by dissolving together two parts by weight of sulphate of iron and one part of sal ammoniac. He employed a piece of iron plate at the positive pole, and at the other a piece of metallic iron scraped bright. He thus produced beautiful iron coins, the metal of which was extremely hard and steel-like, but so brittle that the medals often broke in pieces when taken from the moulds. It was, therefore, thought impossible to make any industrial use of this method.

In 1859, however, M. Jacquin published his method of depositing an excessively thin coating of iron on engraved copper plates, and for this purpose he made use of M. Boettger's process.

Very lately the deposition of iron by galvanism has been greatly improved by M. Klein, of Saint Petersburg. In 1808 he produced before the Academy of Sciences of that capital the results which he had obtained by means of an ammoniacal solution of sulphate of iron, and a Meidniger battery with a piece of iron plate at the positive pole. With these he produced, by precipitation of the iron, not only entire plates of steel from the hardest to the softest, for the reproduction of engraved copper plates, which united the advantages of the softness of the copper for the engravers and the steel-like hardness of the iron for printing from, but he also applied the method to the production of various articles in iron. In all cases the iron precipitated by M. Klein is very brittle, and he found that it was combined with hydrogen, and that its specific gravity was not more than 7·675, that is to say, a little more than rolled iron; but the hydrogen was driven off by annealing, which gave the iron the density of 7·811, which is greater than that of hammered iron, and it then became perfectly malleable, eminently flexible and elastic, and capable of being welded; in a word, possessing all the characteristics of excellent hammered iron.

M. Volger exhibited to the society steel reproductions of engraved plates prepared by M. Klein, a block made up of strips of the deposited iron welded together, forged, filed and polished, and a shield reproducing perfectly an elaborate *repoussé* composition of the "Battle of the Amazons," with a plateau weighing 15 lbs. The most valuable application of electro-iron was pronounced by M. Volger to be, in its employment in stereotype works, and especially in the case of printing in colours for the Government bank notes, cheques, stamps, &c., as iron is not affected by mercurial pigments which ruin copper, type, and other metals. *Iron.*

# *Practical Literature.*

## BOOKS FOR AMATEUR WORKMEN.[1]

THE Autotype Manual, issued by Messrs. Spencer, Sawyer, Bird, and Co., is a most useful and desirable addition to the library of the amateur photographer; in it will be found full and plain instructions for the production of permanent photographs. The art of photographic printing in permanent pigments has of late years made such rapid advances, and the results are so far beyond those obtained by the silver process, both as regards delicacy of detail, and the still more important point of absolute permanency, that this, the latest contribution to our knowledge of the subject, will be welcomed by all photographers. Messrs. Spencer, Sawyer, Bird, and Co. have introduced many improvements, and have much simplified the processes in many important respects, thus rendering it more within the reach of the means of most amateurs. They supply a complete apparatus, which packs in a box of less than two cubic feet capacity, by means of which all the operations for obtaining pictures of the dimensions of 10 in. by 12 in. can be performed on a table 4 ft. square.

In this, the fourth edition of the Manual, will be found a description of the system of Monsieur Lambert, whose method of working has only recently been introduced into this country. Monsieur Lambert's improvements enable the operator to produce pictures of the most exquisite beauty and delicacy.

The two little books issued by Messrs. Bemrose have the merit of being simple and concise; they give practical instructions to the amateur in the (to many) fascinating art of fret-cutting and marquetry, and hints as to the least expensive way of providing oneself with the necessary tools. Messrs. Bemrose supply most of the tools, and a great variety of designs.

A small book, issued by the same firm, is perhaps better suited to the tastes of our fair friends; it bears the title, "Mosaicon," and is a pretty amusement. It consists in inlaying various coloured papers in a framework of wood or other material. Form is given to the paper, or card, by means of their being curled or bent into certain shapes to represent flowers, geometric or other designs; these are then, with the aid of glue or gum, placed in their respective positions, and so become imbedded inside the framework, which gives solidity and protection to the inlaid design.

[1] *The Autotype Process; being a Practical Manual of Instruction in the Art of Printing in Carbon, or other Permanent Pigment; with a Notice of the Autotype Mechanical Printing Process.* London: Spencer, Sawyer, Bird, and Co.

*Manual of Buhl-work and Marquetry, with Practical Instructions for Learners, and ninety coloured Designs.* By W. Bemrose, jun. London: Bemrose and Sons.

*Instructions in Fret-cutting, with Designs.* By W. Bemrose, jun. London: Bemrose and Sons.

*Mosaicon: or Paper Mosaic, and how to make it. With full Instructions, Diagrams, and Coloured Plates.* By W. Bemrose, jun. London: Bemrose and Sons.

## THRIFT.[1]

TO the practical man Mr. Smiles' book will furnish abundant food for thought, as to what to do to ameliorate the condition of the people in his employment, and how to do it. Apart from its being one of the highest duties of an employer of labour to use his position to influence for good the moral and intellectual characters of those who in a certain degree look to him for guidance, and who often emulate his example, it is a paying matter to both parties. For, there can be no possible doubt but that a master is infinitely better served by the man who is in the enjoyment of health, happiness, and contentment, than by the one whose health is impaired by either self-indulgence, or bad living and lodging, or by both, and whose future prospects are no brighter than the vision of becoming an inmate of the poor-house or a burden to his children.

Mr. Smiles' chapters on co-operative companies, life-assurance, penny banks, and savings' banks, are especially valuable; in connection with the latter he tells us that to Mr. Charles William Sikes, the son of a Huddersfield banker, we owe the introduction of the Post-Office Savings' Banks, an institution which has already done much to render the workman more independent and self-reliant, and which we trust to see accomplish still further and grander results at no very distant date; the individual example and encouragement, and the opportunity for making a beginning, are in many cases all that is wanted to encourage the more extensive use of it. Mr. Sikes, speaking at the Social Science Association, predicted the success of the institution in the following words:—

"Should the plan be carried out, it will soon be doing a glorious work. Wherever a bank is opened and deposits received, self-reliance will to some extent be aroused, and, with many, a nobler life will be begun. They will gradually discern how ruthless an enemy is improvidence to working men; and how truly his friends are economy and forethought. Under their guidance, household purchases could be made on the most favoured terms—*for cash;* any wished-for house taken at the lowest rent *for punctual payment;* and the home enriched with comforts until it is enjoyed and prized by all. From such firesides go forth those inheriting the right spirit,—loving industry, loving thrift, and loving home. Emulous of a good example, they in their day and generation would nobly endeavour to lay by a portion of their income. Many a hard winter and many a slack time would be comfortably got over by drawing on the little fund, to be again replenished in better days. And if the plan were adopted, remembering that it would virtually bring the Savings' Bank within less than an hour's walk of the fireside of every working man in the United Kingdom, I trust that it is not taking too sanguine a view to anticipate that it would render aid in ultimately winning over the rank and file of the industrial classes of the kingdom to those habits of forethought and self-denial, which bring enduring reward to the individual, and materially add to the safety of the State."

We have derived much pleasure from the reading of Mr. Smiles' book, and we trust no little profit.

## MAGNETISM AND ELECTRICITY FOR ELEMENTARY CLASSES.[2]

THIS book is published in the same series as, and uniform with, the work noticed in No. 11, New Series, p. 352, entitled "Inorganic Chemistry for Elementary Classes," and it is constructed on precisely the same principle as that book. The object and purpose of the two books are identical, and perhaps nothing more is needed, either by way of recommending it to those who use such so-called aids to the study of science, or by way of warning off those who, in our opinion, wisely refuse to attempt to get up a subject by their assistance, than for us to quote the opening passages of the preface. They are as follows:—

"This little book completes the elementary course of experimental physics, as set forth in the syllabus of the Science and Art Department. Every question which has been set in the elementary stage since 1867 up to the present year has been answered, as well as a great number of the advanced ones, or such hints have been given as will enable an intelligent student to see the meaning of the question." After some instructions to students and teachers, the preface further says: "The pupil will then be able to take up the May papers with confidence."

Taking up "the May papers with confidence," and answering the questions set by the examiner, is thus confessedly the chief end to which the book is written, and, having accomplished this, the author no doubt thinks that he has aided in disseminating scientific knowledge. How little such works as these succeed in doing in this direction may be made painfully evident, by setting a student who has been crammed to pass his examination to write a paper on his subject twelve months after he has taken his certificate—the result, we venture to predict, will not be a cheerful one for either teacher or student.

## ELEMENTARY MAGNETISM.[1]

ONE fruitful source of the calamities which occur at sea through ships getting out of their reckoning, and one to which not nearly sufficient attention has been given by those concerned, is the local deviation of the compasses, caused chiefly by the presence of iron on board; and, although care is always taken in properly regulated ships to so place the metal that it shall not affect the compasses, yet the nature of the science of magnetism is as a rule so imperfectly known to those who have to deal with the matter that proper and efficient precautions are seldom taken. The pamphlet before us is written with a view to disseminate more exact knowledge on the subject, to give some practical rules for avoiding the dangers to which the proximity of iron to the binnacle and other causes influencing the compasses so frequently give rise. Owing to the large quantity of iron used in the construction of ships and the increasing number of iron vessels now afloat, the subject is one which daily assumes greater importance, and we are glad to note that this brochure has already reached a second edition

It is written with clearness and precision, and the leading facts of the science are set forth with lucidness and brevity, while the practical application of it is dealt with as by one having the authority which experience gives.

In this edition the author has added some instructions and rules for finding and tabulating the errors of ship's compasses, which will be found to possess considerable utility, and we confidently recommend the pamphlet to all who have to deal with the difficult task of guiding our ships across the trackless ocean, and who have found themselves, as all navigators almost at one time or another have done, getting out of their course by the local perturbation of their compasses.

## ELEMENTARY ANALYTICAL GEOMETRY.[2]

THIS is a new edition, with such alterations and additions as to warrant us in saying that it has been almost rewritten, of one of the valuable series published by the Messrs. Bell under the title of "The Cambridge School and College Text Books." A large number of new and more difficult questions than were in the preceding edition have been added, as also a list of formulæ, while new chapters have been given on focal properties of conics, and on abridged notation and trilinear co-ordinates; the central conics are discussed together, and the chapter on the general equation has been enlarged.

The work is one that has already taken its place in those forms in which the subject is taught, and the additions and revisions contained in this new edition will give to it an increased and abiding value.

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[1] *Thrift.* By Samuel Smiles, author of "Character," "Self-Help," &c. London: John Murray.

[2] *Magnetism and Electricity for Elementary Classes, designed chiefly for use in the Elementary Stage of Classes in connection with the Science and Art Department, South Kensington.* By W. A. Snaith, LL.D., &c. Seventh Edition. Manchester: John Heywood; London: Simpkin, Marshall, and Co.

[1] *Elementary Magnetism, and the local attraction of Ship's Compasses adapted for the use of Navigators; with practical rules for finding and tabulating local errors of Ship's Compasses.* By George Parson, Master Mariner. Sunderland: Thomas Reed and Co.

[2] *Elementary Analytical Geometry.* By the Rev. Thomas G. Vyvyan, M.A., Fellow of Gonville and Caius College, Cambridge, and Mathematical Master of the Charterhouse. Cambridge: Deighton, Bell and Co.; London: George Bell and Sons. 1875.